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Convention Papers

The list of papers presented last week at the 58th annual meeting of the American Foundrymen's Society is indeed imposing. It follows fairly closely established tradition, but this year there are a few extra contributions which emphasize the need of the modern foundryman to absorb the lessons germane to increased productivity evolved by the engineering side of industry. That is, they are of the type presented to the recent conference organized by the Council of Ironfoundry Associations on work study and methods engineering. As in recent years, increasing attention is being given to making the foundry "a better place in which to work and a better neighbour to the community." Thus, there are two papers covering the suppression of dust and the like resulting from cupola operation. Like many other attempts at providing better conditions—some of the devices put forward turn out to be profitable investments. In a paper by Mr. R. M. Ovestrad, it is stated: "Prior to the collector installation, one man was required for 40 hours a week, 50 weeks a year, to remove refuse from the roof area. It is estimated that while melting about 200 tons per 16 hours, we dropped 3 to 5 (short) tons of fly-ash on the roof and adjoining areas. At present we spend 80 man/hours twice a year for roof clean-up and part of that is due to other dirt sources." A second paper speaks of 10 to 12 man/hours per week. Both methods put forward utilize water curtains through which the exit gases pass.

It is interesting to note the attention now being given to surface finish and narrow dimensional tolerances in all types of castings and there are papers on shell moulding, investment casting, high-pressure moulding, and control of sands using the conventional processes. It is evident that engineers throughout the world are seeking to reduce machine-shop costs and this is a factor of increasing importance in our industry. As in this country, research of a more profound character is being prosecuted on the shell-moulding process. A good casting skin requires the use of a fine sand, but the smaller the grain size the greater the consumption of resin. Hence, comes the suggestion by the winner of a British jubilee-award paper that shell moulding might with advantage follow the age-old process of using a "facing sand" backed-up by coarser material—that is, a cheaper and lower resin-consuming sand.

This well-balanced programme presented by the A.F.S. papers covers in an interesting manner all phases of foundry practice—both practical and theoretical. The only paper on nodular-graphite iron is one which deals with risering. There was one out-of-the-way paper on "Why did it Fail?" by Mr. M. V. Hiramsimchuk. In it, there are interesting analyses of such matters as shank failures of foundry chisels and how shot-peening improves tool life. It may be that here is something—perhaps normally neglected—which is worth investigating by the larger concerns. Metal penetration into moulds and cores is a subject which has received attention in this country. In America it is being studied by committee 8-H. The members of this committee proceeded along the lines of using cores of increas-

Convention Papers

ing ramming density and treating the surfaces with graphite and silica washes. Ramming density was without much effect on surface-washed cores, but there was a little more penetration with decreasing density in unwashed cores. There is such a large volume of papers that it is difficult to pick out just a few for mention, for it is very easy to miss cardinal points not exactly "hiding their light under a bushel," but beneath a veritable mountain of technology.

Industry and Photography

The applications of photography in industry are legion. From the reproduction of a company's products for advertising purposes to the portrait of the managing director for publication in the Press, the photograph has its part to play. It can describe processes for educational purposes, while its usefulness in the recording of outstanding events for present generations and posterity has long been exploited.

The National Exhibition of Professional Photography, which opened at the R.B.A. Gallery, Suffolk Street, London, S.W.1, last week, until June 1, shows that the industrial photograph can have mood and beauty as well as unerring accuracy. One industrial exhibit which received an award of merit was a photograph by P. G. Collins of fabricated pipe welding, presented by courtesy of the South Durham Steel & Iron Company, Limited. Another depicting a crucible-melted alloy before pouring, by Maurice Broomfield, was exhibited by the courtesy of the Distillers Company, Limited.

Purchasing Officers' Association

The Purchasing Officers' Association is holding a Scottish regional conference at the Central Hotel, Glasgow, on Saturday, May 22, in conjunction with a visit which the national Council of the Association is paying to that city. At the two sessions in the morning, there will be a discussion upon the comparative facilities offered by the rail and road services and a paper on "Professional Education and the Purchasing Officer", given by Mr. J. Ferguson, B.Sc.

At luncheon, the principal speaker will be the Earl of Verulam, a patron of the Association. During the afternoon, papers will be given on "Scottish Industrial Trends," by Mr. C. A. Oakley, B.Sc., Ed.B., and "Necessity and Invention" by Mr. J. McCallum, chairman of the Association's Glasgow branch. The conference will conclude with a session entitled "Opinion on our own Affairs" at which members' questions will be answered by a panel of visitors from the national Council.

A.F.S. Awards

At the annual general meeting of the American Foundrymen's Society, the following awards were made: The *William H. McFadden medal* to Mr. Walter E. Sicha (manager, Cleveland Research Division, Aluminum Company of Jamaica); the *Joseph S. Seaman medal* to Mr. Thomas E. Eagan (research metallurgist, Cooper-Bessemer Corporation); the *Peter L. Simpson medal* to Mr. Roy A. Gezelius (General Steel Castings Company); *Life Membership*, Mr. Leroy P. Robinson Archer-Daniels-Midland Company); *Honorary Life Membership*, Mr. Earl M. Strick (Eric Malleable Company), and Mr. Collins L. Carter, retiring president (Albion Malleable Iron Company).

I.B.F. Golf Meeting

Non-playing members of the Institute of British Foundrymen and their wives are particularly welcome at the annual golf meeting to be held at Woodhall Spa, Lincolnshire, from October 2 to 3. All will stay at the Golf Hotel in one party. The details of the arrangements are as follow:—

The meeting lasts from Friday evening to Sunday afternoon, for which inclusive terms are offered at the hotel. The standard scratch score is 74 and handicaps are limited to 24. A course allowance will be made, for which purpose competitors are asked to provide a score card of the course on which they are handicapped.

Saturday morning—This will comprise a medal round of 18 holes; couples will be arranged on a similar handicap basis; the lowest net score returned wins the I.B.F. Handicap Challenge Cup to be held for one year (present holder, Mr. H. C. Hanson) and the lowest gross score returned wins the I.B.F. Scratch Challenge Cup to be held for one year (present holder, Mr. E. W. Pugh). The two winners will also be presented with the usual I.B.F. tankard prizes kindly presented by the president of the Institute, Mr. E. Longden. No competitor can win more than one prize in the morning. Ties, if any, will be decided on the last nine holes, or if necessary on the last 12 or 15 holes played; sweepstakes will be divided There will be a veterans' prize, for which those aged 55 and over are eligible. Concurrently with this competition, the Coronation Shield, will be competed for. Teams of three from each branch of the Institute to be nominated by 10 p.m. on the Friday, and the branch team with the lowest net aggregate wins and holds the shield for one year. (Present holders, Birmingham.)

Saturday afternoon—Greensome foursome against "bogey," under ¾ of combined handicaps for a 5/- per head entrance fee and sweepstake—¾ to winners, ¼ to runners-up. Two "Lincoln Imps" will be awarded to the winners, kindly presented by the Lincolnshire branch. Partners will be drawn on the "sheep and goats" basis.

Sunday—Four-ball foursomes against "bogey" ¾ handicaps, partners to be arranged by individual choice, for one dozen golf balls, kindly presented by Mr. R. S. Darby. Sweepstake arrangements to be the same as for Saturday afternoon.

Green fees of 7/6d. per day to be paid to the I.B.F. golf secretary (one round 5/-); starting times: mornings 8.30 a.m. and Saturday afternoon 2 p.m. A time sheet for Saturday morning will be posted in the hotel on Friday night. The Ladies' Competition will be for the Coronation Rose Bowl, kindly presented by Mr. E. G. Evans—the highest Stableford score wins and the winner keeps the bowl for one year. Entrance forms and details of accommodation are now available from the hon. secretary, I.B.F. Golfing Society, Mr. P. G. Pennington, c/o Tees Foundries Limited, Tees Iron Works, Middlesbrough.

HEAD, WRIGHTSON & COMPANY, LIMITED, engineers, founders, etc., of Thornaby-on-Tees (Yorks)—A final dividend of 20 per cent. makes a total of 25 per cent. in respect of the year ended January 31, 1954, absorbing £81,211. For the previous period of nine months there was a 12½ per cent. final payment, making 17½ per cent., requiring £56,109. The group's trading profit amounted to £887,358, compared with £658,709, of which the parent company contributed £528,895, against £299,102 for the previous nine months.

Nodular Cast Iron*

Present Position and Future Prospects as an Engineering Material, with Special Reference to Suitability for Crankshafts

By S. B. Bailey, M.Sc. (Eng.), M.I.Mech.E.

The historical development of iron having graphite present in the nodular form as cast, is traced from the patent application by Morrogh and the British Cast Iron Research Association (1946)† to its selection as a crankshaft material by the Ford Motor Company in 1952. The economics of the production of nodular iron by various methods is discussed and it is concluded that material produced by the magnesium-nickel process now in use cannot compete in price with established materials such as carbon steel and malleable iron. Methods for direct addition of magnesium to molten iron are described, and it is concluded that application of these methods to low-sulphur irons from basic cupolas may completely alter the situation.

The engineering properties of nodular cast iron are compared with those of other ferrous metals. It is concluded that nodular irons in the as-cast condition may be used instead of high grade flake-graphite irons for components not subject to shock loading, and instead of malleable irons in applications where 2-4 per cent. elongation at fracture is adequate. The annealed nodular cast irons may be used, where their extra ductility and impact resistance are considered essential, to replace malleable irons and cast or forged carbon-steels. Their chief advantage over malleable irons lies in the shorter heat-treatment they require, which becomes economically more important as the size of a casting increases and as its selling price per lb. falls. As a replacement for carbon steel, nodular cast iron will be attractive for components which are difficult to cast or which require high surface-hardness with medium strength and impact resistance. However, the extent to which nodular cast iron replaces any of these materials will be determined largely by the price at which it can be produced; this will have to be decreased very considerably before it becomes competitive. Ultimate output of nodular cast iron in Britain in peace time is likely to be limited by the high cost of the low-phosphorus ore which is necessary for its production; in war time, its output might be severely restricted by the difficulty in importing this ore.

The particular application of nodular cast iron to crankshafts is discussed in detail. It can replace alloy flake-graphite irons with a gain in ductility and impact resistance, and is already replacing graphitic cast steel, chiefly because of its better founding properties, and because its lower pouring-temperature facilitates the use of mass-produced shell moulds. It seems doubtful whether its fatigue properties will permit of its replacing the forged low-alloy steel which is used for most British automobile crankshafts, unless some reduction in engine specific-power output is accepted.

Introduction

Nodular (or spheroidal-graphite) cast iron is a comparatively new engineering material: its microstructure, together with those of ordinary flake-graphite grey cast iron and blackheart malleable cast iron for comparison, are shown in Figs. 1, 2, and 3.

Ordinary grey cast iron contains free graphite particles in the form of thin flakes (Fig. 1) which break up the pearlitic matrix, thus greatly reducing the strength of the material and giving it negligible ductility. Grey cast iron has excellent founding properties but its physical properties limit its engineering applications. Before the advent of nodular cast iron, ductile cast irons could only be produced by heat-treatment of white cast irons: this either substantially removed the carbon (whiteheart malleable cast iron) or else precipitated it as free graphite (blackheart malleable cast iron). Graphite precipitated in this manner comes out of solution as discrete agglomerations of small particles (Fig. 2): These agglomerations break up the matrix far less than do the thin flakes of graphite in ordinary grey cast iron and the material is therefore stronger. It is also much more ductile because it has a ferritic instead of a pearlitic matrix. Unfortunately, the long, high-temperature heat-treatment which is necessary makes this material rather expensive.

In nodular cast iron, the graphite particles are produced as small nodules in the as-cast material (Fig. 3). The pearlitic matrix is very strong and has measurable ductility. This can be greatly increased by a short, high-temperature heat-treatment process which produces a weaker, ferritic matrix.

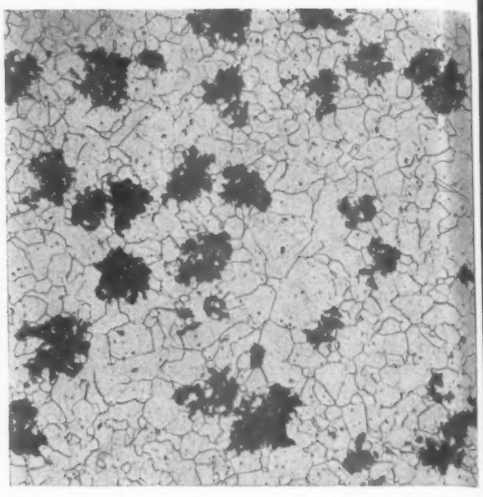
The pioneers in the development of a successful process by which the nodular-graphite structure could be obtained in the as-cast material were the British Cast Iron Research Association (B.C.I.R.A.) and the International Nickel Company, Inc., the former using cerium *mischmetall*, and the latter

*Abstracted from a Paper presented at a general meeting of the Institution of Mechanical Engineers in London, arranged in conjunction with the automobile division and the applied mechanics group. The Author is on the staff of Intelligence Division, London Headquarters, Department of Scientific and Industrial Research.

†An alphabetical list of references is given in Appendix VI.

[Courtesy B.C.I.R.A.

FIG. 1.—*Microstructure of flake-graphite grey cast iron* × 100.



[Courtesy B.C.I.R.A.

FIG. 2.—*Microstructure of blackheart malleable cast iron* × 100.

magnesium, as the nodulizing agent. B.C.I.R.A. filed their British patent application for the cerium process on July 22, 1946 (Morrogh and B.C.I.R.A. 1946); the Mond Nickel Company filed their application for the magnesium process on March 22, 1947 (Mond Nickel Company 1947), this being based on a communication from the associated company, the International Nickel Company, Inc., which filed a similar application in the United States nine months later (Millis, Gagnebin, and Pilling, 1947). The magnesium process proved to be the more attractive commercially, but, when used with irons containing certain trace elements such as titanium and lead, it often failed to produce a substantially nodular structure. Morrogh, at B.C.I.R.A., discovered that these subversive elements could be neutralized by the addition of a very small amount of cerium (Morrogh 1952), and he applied for patents covering the combined-addition process; one of these patents (for hypo-eutectic irons containing copper) has since been granted (B.C.I.R.A. 1951). The Mond Nickel Company have also been working in this combined-addition field, and has filed patent applications which, at the time of writing, are still pending.

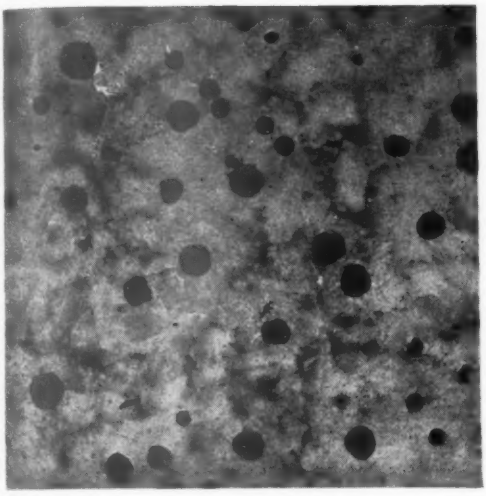
In order to obtain high impact-resistance, ductile irons must contain less than about 0.1 per cent. phosphorus. Known ways of reducing the phosphorus content of pig-iron are expensive, and they reduce the carbon content as well, leaving steel, with its difficult founding properties of high melting-point, poor fluidity, and high solidification shrinkage. High-quality wrought iron and ductile cast irons must therefore be made from low-phosphorus pig-iron, which must in turn be produced from low-phosphorus ore such as hematite (red ironstone). High impact resistance being a desirable property in nodular cast irons, these must also be made from low-phosphorus pig-iron.

The graphite present in cerium- or magnesium-treated iron, as-cast, will not be nodular unless the sulphur content is reduced to a very low level. The more sulphur there is in the iron taken from the cupola, the greater will be the amount of magnesium or cerium needed to produce the nodular structure, and the greater will be the cost of the process. Nearly all the iron foundries in Britain at present use cupolas having acid refractory linings, which yield an iron containing between 0.08 and 0.14 per cent. sulphur. If basic linings of dolomite or magnesite were substituted, the sulphur content could be brought down to between 0.01 and 0.04 per cent. Many foundries in the United States have changed over to basic linings in recent years, but in Britain there has been little experience with them, except at the works of the Ford Motor Company at Dagenham. Basic linings could be adopted in Britain on a large scale, but they would cost more than the existing acid linings and might be more difficult to patch (Bogan, 1952). However, there can be little doubt that the extra cost of using basic linings would be small compared with the saving in the cost of magnesium or cerium required to produce nodular cast iron from a given pig-iron.

PRODUCTION METHODS

The original B.C.I.R.A. cerium process for producing nodular cast iron can only be successfully applied to hyper-eutectic irons. It will not work satisfactorily with a section thickness which is greater than about 4 in., or with sulphur contents greater than about 0.04 per cent., and there is now little commercial interest in this process.

The magnesium process, it was originally claimed, was much less sensitive to variations in carbon, silicon, and phosphorus content than the cerium pro-



[Courtesy B.C.I.R.A.

FIG. 3.—*Microstructure of pearlitic nodular cast iron* × 100.

cess. However, the iron in the ladle is at a temperature of about 1,450 deg. C. when the magnesium treatment is carried out, and as magnesium boils at 1,120 deg. C. (2,048 deg. F.), it was not at first considered possible to add pure magnesium without serious hazard; and even if the hazard were accepted, the process would be very extravagant, since most of the magnesium would be vaporized, and would burn away without helping to deoxidize and desulphurize the iron. The difficulty can be overcome either by alloying the magnesium with a metal of higher melting point which dissolves easily in molten iron, or by reducing the rate of reaction by mechanical means.

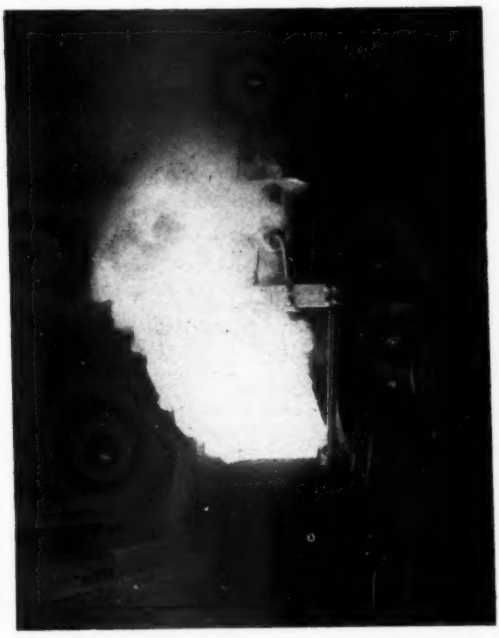
In the United States, the first method was pursued, and nickel was found to be the most suitable metal with which to alloy the magnesium. Nickel will combine with magnesium vapour at temperatures well below 1,000 deg. C. (1,832 deg. F.) and, at these temperatures, there is no explosive violence in the reaction. Addition of the alloy to the metal in the ladle is accompanied by the usual blinding light and clouds of oxide fumes associated with burning magnesium (Fig. 4), but, provided one stands well clear of the ladle, the process looks more dangerous than it really is. Copper can be used instead of nickel, but nodular cast irons produced with copper/magnesium alloy have had inferior properties to the properties of those produced with nickel/magnesium alloy.

The magnesium process for the manufacture of nodular cast iron is a patented process, for the use of which the patentee currently charges a royalty of between £1 10s. and £2 per ton of finished castings. The 85/15 nickel/magnesium alloy used costs about 5s. per lb. Experience has shown that, when this nickel/magnesium alloy is added to molten iron at 1,450 deg. C., about 50 per cent. of the magnesium content enters into solution in the iron, the rest being lost by burning. Of the 50 per cent. dissolved, part reacts with sulphur to form a magnesium-sulphide slag, and part remains in solution. If the sulphur content of the iron is to be reduced sufficiently to guarantee a nodular-graphite structure, there must be a residual magnesium content of about 0.06 per cent. in the final casting. From this, it follows that the addition of alloy necessary is about 0.8 per cent. plus ten times the sulphur content of the iron to be treated. If a typical figure for the sulphur content of iron from an acid cupola be taken as 0.12 per cent., the alloy addition works out at 2 per cent. For materials with similar founding properties to those of nodular cast iron, about 2 tons of metal are required in the ladle for every ton of finished castings produced; the royalty per ton of treated iron in the ladle is therefore about £1. If the cost of producing one ton of low-phosphorus iron in the ladle is taken as £16, the total cost per ton of treated metal in the ladle works out at £28 5s., made up as follows:—

	£	s.
Low-phosphorus iron in the ladle ..	16	0
45 lb. nickel/magnesium alloy at 5s. a lb.	11	5
Royalty (say)	1	0
	£28	5s.

FIG. 4.—*Reaction in the ladle following an addition of magnesium/nickel alloy to liquid iron.*

[Courtesy of Lloyds (Burton) Limited.



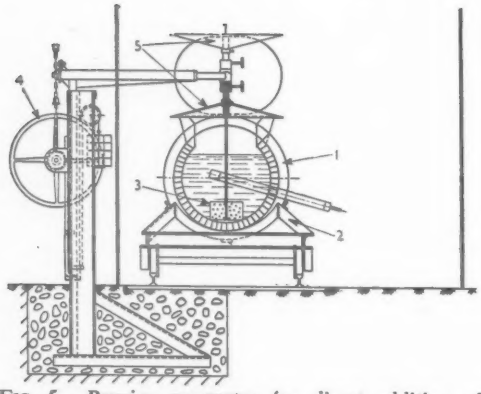


FIG. 5.—*Russian apparatus for direct addition of magnesium.*

(1) Horizontal receiver; (2) chassis; (3) perforated magnesium-container; (4) control wheel; and (5) covers.

A change to the basic cupola might be expected to reduce the sulphur content of the iron to 0.02 per cent., and the addition of alloy necessary to 1 per cent., which would reduce the cost of treated iron in the ladle to £22 12s. per ton. Even this is some 40 per cent. greater than the cost of untreated low-phosphorus iron.

Difficulties

There seems to have been some difficulty in making the magnesium process work reliably even in the United States, where low-phosphorus ores are plentiful and where less scrap of doubtful origin has to be included with the charge; where also low-sulphur metallurgical coke is more readily available; and where a large number of basic-lined cupolas are in service. However, 20,000 "melt tons" of nodular cast iron were produced there in 1950, and 50,000 melt tons in 1951 (British Commonwealth Scientific Office, 1953); the estimate for 1952 of the International Nickel Company is between 70,000 and 100,000 melt tons. These "melt tonnages" are equivalent to 10,000, 25,000, and 43,000 tons, respectively, of finished castings. The corresponding outputs of finished grey-iron castings of all kinds in 1950 and 1951 were 14.67 and 16.07 million tons, respectively (United States Department of Commerce, 1952); 0.16 per cent. of the total output was in nodular cast iron in 1951, the estimated amount for 1952 being about 0.25 per cent.

In Europe, there have been similar difficulties and many failures. Founders have tried to produce nodular cast iron using indigenous ores and scrap iron contaminated with various residual elements, and have produced castings showing little evidence of nodular structure. They have frequently used high silicon-contents to obtain high ductility in the as-cast condition, and these high silicon-contents have resulted in low impact resistance. The castings supplied have sometimes broken in transit, with brittle fractures; sometimes they have failed on test at the customer's works. As a result, many engineering

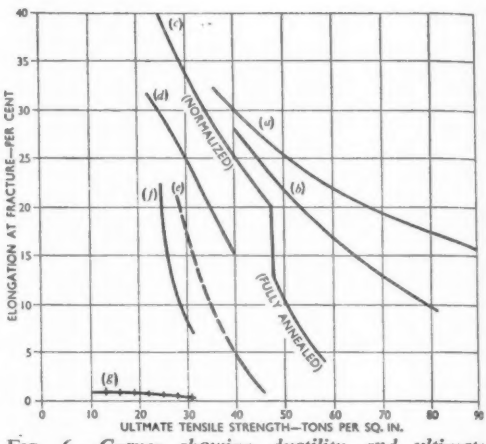


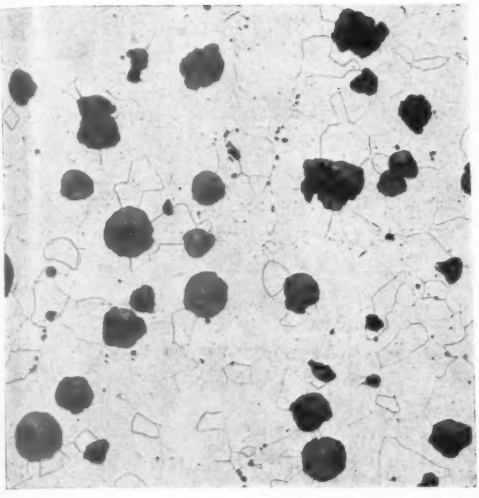
FIG. 6.—*Curves showing ductility and ultimate tensile strength.*

(*a*) Wrought steels; (*b*) cast alloy-steels; (*c*) cast carbon-steels; (*d*) nodular cast irons (heat-treated); (*e*) nodular cast irons (as-cast); (*f*) blackheart malleable irons; and (*g*) flake-graphite grey cast irons.

firms and research organizations have lost confidence in nodular cast iron. The production figures for the United Kingdom have not been published, but it is evident that adoption of the material in industry is not proceeding very quickly.

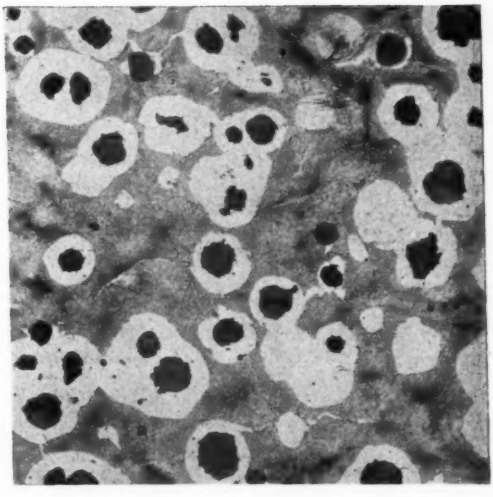
New Methods

The combined magnesium/cerium processes mentioned earlier are stated to have overcome these uncertainties, and, given proper technical control, to be capable of yielding a product which can be guaranteed to have a nodular structure throughout (Morrogh, 1952). If these promises are fulfilled, there should be an increase in confidence in nodular cast iron, but the cost will remain high whilst the expensive nickel-alloy has to be used to get the magnesium into solution. However, it may not be very long before a process is developed which permits the magnesium to be added either direct or alloyed with the ferro-silicon "graphitizer." In Great Britain, some early experiments (Morrogh, 1948) attempted to get round the difficulty of adding magnesium direct, by substituting briquettes of magnesia and ferro-silicon bonded with sodium silicate, the magnesia being reduced by the ferro-silicon at temperatures above 1,100 deg. C. (2,012 deg. F.). In the U.S.S.R. (Berdyanskaya, Tsymbal, and Adamski, 1951) and Italy (Longaretti and Noris, 1952) it has been claimed that successful methods have been developed which slow down the reaction between magnesium and liquid iron by mechanical means; magnesium chips are placed in a perforated steel can, which is insulated inside and outside with refractory; this is plunged into the molten iron in the ladle and kept submerged until the reaction ceases (Fig. 5). In Switzerland and Austria, methods are being developed by which powdered magnesium may be blown into liquid iron with a stream of inert gas. In Germany, direct reaction between magnesium and



[Courtesy B.C.I.R.A.

FIG. 7.—*Microstructure of fully-annealed (ferritic) nodular cast iron* × 100.



[Courtesy B.C.I.R.A.

FIG. 8.—*Microstructure of nodular iron with matrix of ferrite and pearlite (as-cast)* × 100.

liquid iron has been allowed to occur in sealed pressure vessels which avoid the visual firework display normally associated with the addition of magnesium to liquid iron; however, the pressures involved are high (about 150 lb. per sq. in.) and might be considered dangerous in an iron foundry.

In general, direct-addition methods carried out without the use of sealed pressure vessels or inert gas atmospheres, give magnesium recoveries lower than those achieved by simple addition of nickel/magnesium alloy, unless special care be taken in the design of the perforated container by means of which the magnesium is introduced. Berdyanskaya and his co-authors reported that, when using a can completely open at its lower end, the addition of 0.7 per cent. magnesium was necessary to guarantee a nodular-graphite structure with an iron containing 0.14 per cent. sulphur; the magnesium recovery obtained works out at rather less than 25 per cent. Klauzen (1951) reported that the magnesium recovery could be trebled by using a tubular container perforated at the upper end only, but he added that the time of reaction was then so prolonged that undue cooling of the iron might be experienced. With further development, it seems reasonable to expect that a 50 per cent. magnesium-recovery, allied with an acceptable reaction time, will one day be attained without using nickel alloys. The cost of carrying out the combined magnesium/cerium process with a high-sulphur iron will then work out as follows:—

	£	s.
Grey iron in the ladle	16	0
7½ lb. magnesium at 3s. 8d. per lb.	1	8
13 oz. cerium *mischmetall* at 32s. 6d. per lb.	1	6
Total cost per ton	£18	14s.

Irons, from basic cupolas, with a sulphur content, of 0.02 per cent., might be expected to require less than 4 lb. of magnesium and 8 oz. of cerium *mischmetall* per ton of iron, bringing the cost "in the ladle" down to £17 8s. per ton. The higher capital and maintenance costs of basic linings as compared with acid linings will undoubtedly increase this cost, but probably not by very much.

Royalties have not been included in the estimates for these new production methods as some of the patent applications covering the combined magnesium and cerium treatments have not yet been granted; nor has it been established whether it will be possible to operate the combined process without the need for a licence from one or other of the patentees of simple magnesium treatment.

ENGINEERING PROPERTIES

Having seen how the cost of nodular cast iron is likely to fall as new techniques for making it are developed, the engineer will be interested in comparing its founding properties, mechanical properties, and production costs with those of other ferrous metals.

Founding

Nodular cast iron has a much lower melting point than steel, and is more fluid at the (lower) pouring temperature. It flows more easily into moulds of complicated shape; it feeds more easily during solidification in the mould; and the moulds and cores do not have to withstand such extreme temperatures. With the shrinkage characteristics of steel and the pouring and feeding characteristics of ordinary grey iron, nodular iron is less difficult to cast successfully than steel, but more difficult than grey iron. If the nodular iron is correctly produced, and rapid chilling

[Courtesy of Robert Taylor, Limited.

FIG. 9.—*Compressor stator casing, cast in nodular iron, for an aircraft gas turbine.*

of thin sections is avoided, the castings have substantially uniform properties throughout; very thick sections can be cast satisfactorily.

In this particular, the material has a big advantage over whiteheart malleable iron, for castings in whiteheart iron are limited in section thickness to about $\frac{1}{2}$ in. because of economic considerations, the time of heat-treatment increasing with thickness; furthermore, the ductility of the material at the centre may be only half that of material near the surface. Nodular cast iron has a big advantage over blackheart malleable iron in the time of heat-treatment required, but its advantage in uniformity of properties is smaller. The high carbon-content of nodular cast iron makes it impossible to weld this material in its ductile ferritic state without serious embrittlement. The heat-treatment which would be necessary to bring the metal near the weld back to a ductile form would be expensive and might often be difficult to carry out. Consequently, large, complicated castings in nodular cast iron will not readily lend themselves to fabrication by welding, a technique which is now widely employed with large steel castings (Buckley, 1953); this may well be a serious drawback.

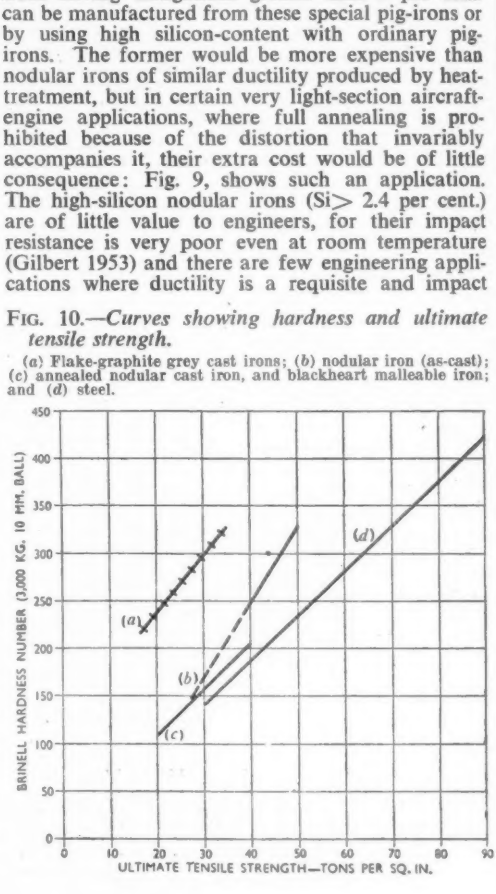
Mechanical Properties

The mechanical properties of nodular cast iron can be varied over a wide range by annealing processes, ultimate tensile-strength and hardness being sacrificed in favour of ductility and impact resistance. The curves which follow have been plotted from information obtained from the sources listed in Appendix I.

Fig. 6 shows the ultimate tensile strengths of six ferrous engineering metals plotted against their elongation at fracture. The heat-treated nodular cast irons to which curve (*d*) applies had been annealed at temperatures between 900 and 960 deg. C. for periods up to 24 hrs., but these times could probably have been safely reduced to 6 hrs.; a typical microstructure is shown in Fig. 7. For the nodular cast irons in curve (*e*), elongations greater than 5 per cent. in the as-cast condition were only obtained with iron produced from very high-grade, Swedish, charcoal pig-irons, containing less than 0.02 per cent. manganese, and melted in an oil-fired crucible furnace; a typical microstructure is shown in Fig. 8. They could not be obtained from ordinary hematite pig-irons or refined pig-irons which contained 0.3-1.0 per cent. manganese and trace elements which discourage the formation of ferrite. As-cast nodular irons having elongations greater than 5 per cent. can be manufactured from these special pig-irons or by using high silicon-content with ordinary pig-irons. The former would be more expensive than nodular irons of similar ductility produced by heat-treatment, but in certain very light-section aircraft-engine applications, where full annealing is prohibited because of the distortion that invariably accompanies it, their extra cost would be of little consequence: Fig. 9, shows such an application. The high-silicon nodular irons (Si$>$ 2.4 per cent.) are of little value to engineers, for their impact resistance is very poor even at room temperature (Gilbert 1953) and there are few engineering applications where ductility is a requisite and impact

FIG. 10.—*Curves showing hardness and ultimate tensile strength.*

(*a*) Flake-graphite grey cast irons; (*b*) nodular iron (as-cast); (*c*) annealed nodular cast iron, and blackheart malleable iron; and (*d*) steel.



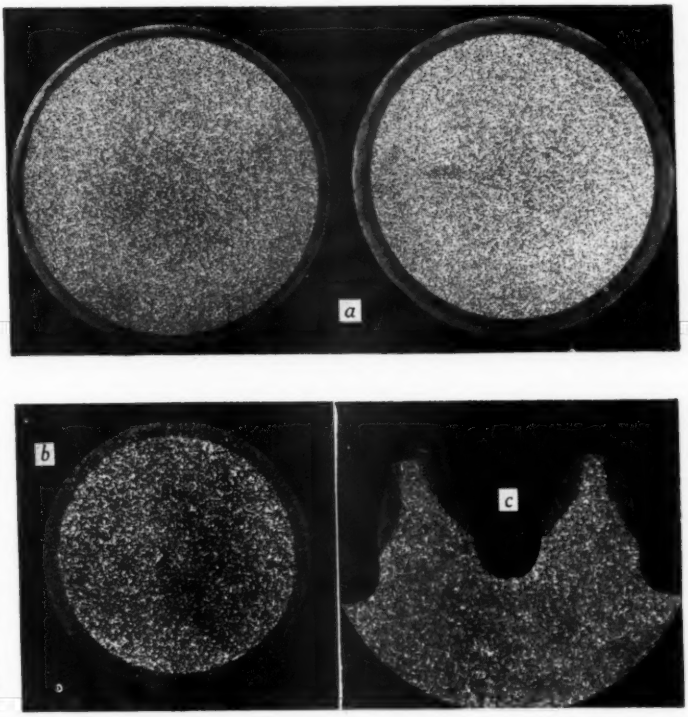


FIG. 11. — *Surface - hardened nodular-cast-iron components: (a) Pearlitic, nodular-cast-iron bars, 1.875 in. dia., oxy/coal-gas flame-hardened by the spinning progressive method, with temperature control. Core hardness, 265 diamond pyramid number; hardened zone, 700 diamond pyramid number. (b) An induction-hardened, pearlitic, nodular-cast-iron bar, 0.750 in dia. Core hardness, 257 Brinell; hardened zone, 725 diamond pyramid number. (c) An experimental 6-diametral-pitch, pearlitic, nodular-cast-iron gear, with teeth oxy-acetylene flame-hardened on a straight-line gear-hardening machine. Core hardness, 264 Brinell; hardened zone, 630 diamond pyramid number.*

[Courtesy B.C.I.R.A.

resistance unimportant. The ultimate compressive strength of as-cast nodular iron can be as high as 90 tons per sq. in.

There is very little published information on the strength of nodular cast irons at elevated temperatures. One investigation made in the United States (Saunders and Sinnott 1952) showed that the limit of proportionality and ultimate tensile strength of an ordinary as-cast nodular iron at temperatures up to 650 deg. C. were higher than those of a carbon steel suitable for high-temperature service. Some results from Saunders and Sinnott's work are given later.

Fig. 10 shows the Brinell hardness of flake-graphite irons, nodular cast irons and steels plotted against ultimate tensile-strength. The curve for steel applies to all types (*i.e.*, wrought carbon-steels, cast carbon-steels, wrought alloy-steels and cast alloy-steels). It is worthy of note that, for a given tensile-strength, the steels have a lower surface-hardness than any of the other ferrous metals shown. Annealed (ferritic) nodular cast irons are a little harder, and as-cast (pearlitic) nodular irons very much harder; in fact, the as-cast nodular irons are as hard as the flake-graphite irons, but stronger. All the materials shown can be surface-hardened to at least 600 diamond pyramid number (55 Rockwell C or 564 Brinell hardness number) by one or other of the chill-casting, flame-hardening, induction-hardening, carburizing, or nitriding processes, whichever may be appropriate (Fig. 11). Such treatments usually increase bending fatigue strength, but some of them may increase notch sensitivity. As in Fig. 6, that portion of the curve for as-cast nodular irons which applies only to material produced from very high-grade, Swedish, charcoal pig-irons is shown by a broken line, since such irons will not be used in Britain for general engineering applications.

The fatigue strengths of engineering components are almost invariably determined by the high stresses which are set up at unavoidable discontinuities of section, such as fillets between crankwebs and crankpins, radial oil-holes, splines, etc. To compare the notched fatigue strengths of the various materials covered by this Paper, it would be desirable to study their behaviour in test-pieces of identical form, so that the theoretical stress-concentration factor at the notches would be constant, and so that the results would not be affected by variations in test-piece size. Unfortuately, no two investigators ever seem to use exactly the same form of test-piece, and it is necessary to make the best use of such information as is available.

Fig. 12 shows notched fatigue strengths in reversed bending plotted against ultimate tensile-strengths. Full particulars of the test-specimens used appear in Appendix II, which also gives the measured fatigue-strength reduction-factors due to the notches, and the theoretical stress-concentration factors at the roots of the notches, the latter having been derived from Neuber's exact mathematical analysis (Neuber 1937) and from Gough's modified Inglis formula (Gough, Pollard, and Clenshaw 1951). No curve for cast carbon-steels has been included because the Author has failed to find any published results of recent bending-fatigue tests on this material. No curve has been drawn through the points plotted for the forged steels, as the Author

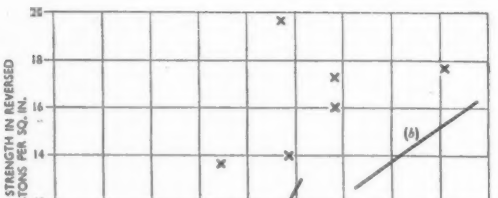


FIG. 12.—*Curves showing notched fatigue strength and ultimate tensile strength; based on tests on small specimens.*

(×) = test results for wrought steels; (*a*) graphitic cast steel; (*b*) cast alloy-steels; (*c*) nodular cast iron (as-cast); (*d*) nodular cast iron (heat-treated); and (*e*) flake-graphite grey cast irons.

is not bold enough to make an arbitrary decision as to where this curve should lie. It will be noted from Appendix II that the theoretical stress-concentration factors for the notches used for the cast alloy-steels, nodular cast irons, and ordinary grey cast irons, were all of the same order of magnitude, whilst those for the wrought steels of lower tensile-strength were very much greater. It is fair to assume that, for components of the size tested, the four curves drawn are strictly comparable, whilst the points representing the wrought steels of lower tensile-strength should be raised considerably.

With larger engineering components, the notched fatigue strengths of all these materials may be expected to fall below the values given in Fig. 12 owing to the adverse size-effect (Phillips and Heywood 1951), which will probably not be the same for all the different materials. So far as the Author is aware, no systematic tests have yet been made to determine the effect of specimen-size on the bending notched fatigue-strength of cast irons, nodular or otherwise.

As a matter of interest, the fatigue-strength reduction-factor obtained for a small radial oil-hole in a hollow cylindrical shaft (where the theoretical stress-concentration factor is 3) is also given in Appendix II as 2.25, the authority again being Gough, Pollard and Clenshaw (1951). From this it will be seen that the reduction in fatigue strength occasioned by the grooves was only in one instance greater than that caused by the oil hole, and it may be concluded that the curves for the grooved shafts do not present an exaggerated picture of the order of fatigue-strength reduction which is to be expected in practical engineering designs.

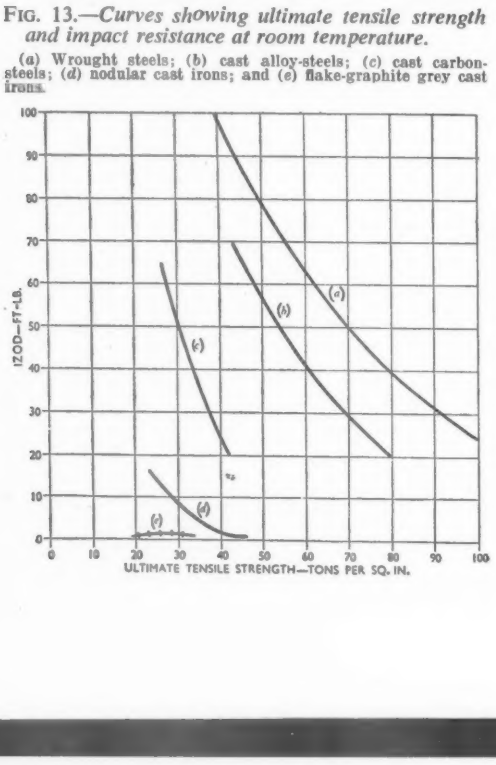
Fig. 13 shows the Izod impact figures which can be obtained from various ferrous metals by suitable heat-treatment. They relate to test-pieces complying with B.S. 131 (British Standards Institution 1933), either 10-mm. square or 0.45-in. dia., notched. The impact figures for the cast steels may seem high to British users, but American steel manufacturers seem to have little difficulty in obtaining the figures quoted and do not appear to be afraid of publishing them. Unfortunately there has, up to now, been no British equivalent to the American "Steel Castings Handbook," but it is understood that a similar handbook is at present in course of preparation by the British Steel Founders' Association, and that this Association believes the American figures to be substantially correct.

It must be emphasized that all these curves have been drawn from typical test results: they represent the properties normally to be expected from the materials concerned, and they should not be confused with specification properties.

(To be continued)

FIG. 13.—*Curves showing ultimate tensile strength and impact resistance at room temperature.*

(*a*) Wrought steels; (*b*) cast alloy-steels; (*c*) cast carbon-steels; (*d*) nodular cast irons; and (*e*) flake-graphite grey cast irons.



Courses in Foremanship

Response to a lecture-discussion course on modern foremanship which began in Glasgow recently has exceeded all the expectations of the organizers. When the Glasgow & West of Scotland section of the Institution of Industrial Supervisors arranged the course an attendance of between 40 and 60 was expected, but at the first meeting on May 5 more than 250 were present.

The course, to last five weeks, is being held on Wednesday evenings in the offices of the Institution of Shipbuilders & Engineers, Elmbank Crescent, Glasgow.

The course has been arranged in collaboration with the members of the staff of the Department of Industrial Administration of the Royal Technical College, Glasgow, who are providing the lecturers. The subjects chosen so far have been on such topics as "The Foreman's Part in Management" and "The Foreman and Work Study."

Budget & Finance Bill, 1954

By F. J. Tebbutt

Many of the provisions of the Ways and Means Resolutions (1954 Budget), now contained in the Finance Bill, 1954, are in the direction of assistance to productive industry, and so to the export trade and to employment totals. That is, as respects machinery and plant there are provisions covering depreciation matters, the new allowance as regards these items, and also in respect of certain favourable tendencies as regards death duties.

New Investment Allowance

By the Finance Act, 1953, the provisions concerning " initial allowances " which apply for " machinery and plant " (new and second-hand) and " industrial buildings," which had been suspended, were once again brought into operation so that, as regards " machinery and plant," twenty per cent. of the expenditure incurred on or after April 15, 1953—and for " industrial buildings," 10 per cent.—is allowed as an " initial allowance." By the Budget resolutions, 1954 (eventually to be the Finance Act, 1954), there is introduced a new allowance called an " investment allowance," to apply in respect of certain capital expenditure incurred after April 6, 1954, for " machinery and plant " and for " industrial buildings." This " investment allowance," however, will not apply for second-hand plant and machinery and ordinary motor-cars; these latter items will continue to come under the " initial allowances " rules, as formerly.

The " investment allowance " will be 20 per cent. for plant and machinery; for scientific research expenditure and for plant hitherto dealt with on the " renewals rule " basis, and 10 per cent. for industrial buildings. In the case of " mining works," the allowance is 20 per cent., whereas the " initial allowance " is 40 per cent., so that the present " initial allowance " is more than the new allowance; in these cases an option will be given to take the " initial allowance " instead of the " investment allowance." As regards the " scientific research " expenditure, the allowance (20 per cent.) will apply to expenditure on the construction of buildings or works or the provision of new machinery or plant.

What the new investment allowance means is that the relevant firm, in the long run, will get an allowance for more than has been spent, whereas under the initial-allowance provisions, while the firm received a greater proportion of the total allowance in the first year after the money had been expended, in the end it mostly worked out the same as if just the " wear-and-tear " allowance applied throughout. In short, it really means that by the investment allowance provisions, the total allowance will be really 120 per cent. of the original cost, and the " wear-and-tear " allowances will still apply.

Death Duty Alterations

An important provision concerning Estate Duty (*e.g.*, Death Duties) is expected to assist what are termed " family " businesses, where the incidence of death duties on a death has sometimes operated with great severity having regard to the duties to be paid.

The rates of Estate Duty have been changed from time to time, those currently operative being contained in the Finance Act, 1949. The rates of this duty are scheduled in a general scale, being on different amounts, the rates being heavier as the value of the estate goes upwards, ranging from 1 per cent. for an estate value of £2,000 up to £3,000, to 75 per cent. for estates exceeding £750,000 up to £1,000,000. For estates over £1,000,000 in value the duty is 80 per cent.; estates up to £2,000 are exempt. The new Budget resolutions of 1954 are now embodied in the Finance Bill, 1954, later to become the Finance Act, 1954. The provision mentioned earlier, which is expected to help family businesses, lays down that, where a business or an interest in a business passes on a death, any Estate Duty chargeable on the death in respect of industrial hereditaments used in and occupied for the purposes of the business, or in respect of machinery or plant so used, shall be charged in accordance with a scale of rates of duty representing the usual scale for the time being in force, with a reduction of 45 per cent. in each of the rates. As regards any shares or debentures in respect of which Estate Duty is chargeable, only the proportion attributable to the industrial hereditaments and machinery or plant will attract the 45 per cent. reduction. It will be seen that, as regards the 45 per cent. rebate, ordinarily this will mostly apply to industrial hereditaments and machinery and plant.

An important provision relates to shares, etc., which are valued on the assets basis, and which have been sold to an independent purchaser. Broadly, this means that the Estate Duty valuation shall be brought into line with the sale price. For this provision to apply, there are certain conditions to be fulfilled as follow:—That no person, either as vendor or as having an interest in the proceeds of sale was a relative of any person concerned, either as purchaser or as having an interest in the purchase; that the sale was made at arm's length for a price freely negotiated at the time of sale; and that the price obtained for the shares or debentures on the sale was less than the value as ascertained by the usual procedure. Too often, it has been claimed that the duty payable has been excessive, through the price of shares, etc., having been estimated as being of more value than they were. This has arisen mostly as follows: Where the deceased's shareholding was in a public company, the Stock Exchange price on the day of death is the value, but when the shares have been in a private company—most family businesses come under the head of private companies—the price of the shares have been mostly estimated and claims are made that the Revenue Authorities have in many cases estimated too high a value. The limit for non-aggregation of small estates has been raised from £2,000 to £10,000, and account is to be taken of settled property derived from the deceased (whether or not settled by him) in determining whether the limit applies. This provision is expected to enure to the benefit of deceased's family.

It should be noted that these new Death Duty provisions will apply in respect of deaths occurring after the passing of the Finance Bill, 1954.

National Society of Master Patternmakers

The first London meeting of the National Society of Master Patternmakers was held at the Waldorf Hotel on Wednesday, May 5, Mr. B. Levy presiding. The meeting opened with a short address by the president, during which he outlined the objects of the Society, stressing in particular the benefits to be derived from personal contact between members and attendance at meetings. It was proposed to have four meetings only in the first year and to get as much business as possible done at each of those meetings. Mr. Levy stressed the growing importance of patternmakers generally, and of master patternmakers in particular, to the engineering industry as a whole, mentioning the service of advice and technical knowledge, plus the personal interest which most master patternshops render to industry, quite apart from the value that is embodied in their products and the facilities of machinery and plant made available.

The modern master patternshop, he continued, had many thousands of pounds worth of machinery available to service the smaller foundry concerns in particular, which would otherwise find it uneconomical to maintain such equipment for ordinary requirements. He also mentioned that by personal attendance at meetings, members of the Society could contribute to the common pool of knowledge and goodwill, discuss their personal problems and many other points that would otherwise remain off record. The Society aimed to extend the activities of master patternshops in the amount of work and goods destined for export, and in this connection the chairman had some distinct possibilities in mind.

Membership up to that date had already reached forty-seven, and it was with pleasure that the Society welcomed the support of the chairmen of both the Coventry and Birmingham Master Patternmakers' Associations.

The president then invited questions on matters relating to the Society's activities and general set-up, pointing out that the objects and rules were of a preliminary character and that the Council would be very pleased to receive suggestions from members.

Film Show

Mr. J. M. Langham, of J. Stone & Company (Charlton) Limited, was then introduced to members and invited to present his film showing the making of moulds and castings for propellers for the Queen Elizabeth, etc. Both the film and the admirable commentary given by Mr. Langham were loudly acclaimed, the Chairman remarking that hesitancy in putting questions paid tribute to the clear and explicit manner with which the subject had been presented.

MR. SEYMOUR enquired from the lecturer the number of castings which might determine the employment of a full pattern instead of the strickle methods demonstrated in the film, to which Mr. Langham replied that the minimum economic number found to justify a full pattern was six, except in the case of variable-pitch propellers, where metal patterns had been made for as few as three off.

MR. BROWN, in proposing a vote of thanks, said how much he had appreciated the instructional value of the film, and he wondered what sort of a quotation and variation of price Mr. Langham's firm would receive if they had at any time put out an enquiry for propeller pattern equipment. He, Mr. Brown, had learned much from the film and felt that members owed their sincere thanks both to the directors of J. Stone & Company (Charlton) Limited, and to Mr. Langham and his colleagues for the film and discourse the meeting had received. MR. SEYMOUR, in seconding the vote of thanks, endorsed Mr. Brown's remarks.

MR. LANGHAM, in responding, mentioned the valuable work undertaken by his colleague, Mr. Shepherd, in the preparation of the film, which had been a maiden effort. The distinction of being the very first lecturer to the National Society of Master Patternmakers was also something to value and much appreciated. In reply to a question raised by Mr. Levy, the lecturer stated that it was in fact the patternmakers who were largely responsible for the structure of "skeleton" work and preparation of strickles which played so vital a part in the successful manufacture of propellers.

MR. A. R. PARKES then rose to mention that he was attending the meeting as a representative of the FOUNDRY TRADE JOURNAL and that its facilities continued to be at the disposal of the Society. Space for publication of notices of meetings, technical information, and the use of the Board Room for council meetings, were all available for the asking, and he hoped that the Society would not hesitate to take advantage of the offer. Mr. Parkes mentioned that the Institute of British Foundrymen, founded in 1904, held their first meeting with fewer members than this new Society, yet to-day their membership was over five thousand and in this Jubilee Year of the Institute, the founder members, could they have been alive, would have had cause to be extremely proud. He thought founder members of the National Society of Master Patternmakers had made a very good start and saw no reason why they should not assume full representation of their industry.

Thanking Mr. Parkes for his words of encouragement and help, THE PRESIDENT informed members that the Society had that afternoon held their first official council meeting in the Board Room of the FOUNDRY TRADE JOURNAL, and this hospitality was greatly appreciated.

The meeting concluded with the enrolment of some further members.

I.M.M. Awards for 1953

Among the awards of the Institution of Mining and Metallurgy for 1953 is that of its Gold Medal to Mr. Essington Lewis, in recognition of his long and distinguished services to the Mining and Metallurgical Industries of Australia. Honorary membership of the Institution has been conferred on Mr. Thomas Pryor, a past-president, in recognition of his services to the institution and to mining education.

The Consolidated Gold Fields of South Africa, Limited, Gold Medal has been awarded to Dr. John Stuart Webb, for his work on the development of geochemical prospecting methods, while the premium of 40 guineas has been awarded to Mr. Ralph Daniel, for his paper entitled "Diamond-mining Practice in Kimberley, South Africa."

Mr. Thomas Andrew Henderson receives the Arthur Claudet Student's Prize for his part authorship of the paper entitled "Some Exploratory Experiments on the Formation and Control of Magnetite during Copper-smelting Operations." Finally, the William Frecheville Student's Prize has been awarded to Mr. Cyril Lionel Hall, for his part authorship of the paper entitled "Laboratory Tests on the Concentration of Witherite from the Northern Pennines by Froth Flotation."

Flame-radiation Research

New Experimental Station Opened in Holland

With the upward spiral of fuel costs, founders, along with executives of other metallurgical industries, will become more and more impressed with the need for fuel economy in melting and heat-treatment processes. Thus, general co-operative research and the new experimental station for flame radiation in Holland has special significance. A new test furnace was inaugurated recently at IJmuiden and this is described in the following account.

The heat transfer from flames by radiation can take place either by non-luminous radiation, which is fundamentally a radiation by combustion products in certain wave-length bands in the infra-red or by luminous radiation in which very small soot particles radiate over visible and non-visible wave-length regions. Non-luminous radiation has been the subject of extensive studies and the result can now be applied with fair accuracy to the design of industrial furnaces. Luminous radiation, however, which is generally much more powerful than the non-luminous radiation, has so far only in some special cases been investigated.

Problems Involved

With the growing use of oil and pulverized-coal firing and the increasing proportion of radiant heat transfer, the existing vacuum concerning the properties of luminous flames puzzles furnace designers and users. The luminous radiation itself arises from incandescent, extremely small, soot partticles, which are formed during the combustion, due to thermal cracking and incomplete combustion. The problem is a very complex one, because there is a very strong interaction between rate of combustion, rate of mixing, temperature and chemical reactions. This makes understandable that small-scale experiments on luminous radiation proved not to be applicable to industrial furnaces because in a small scale model only one or possibly two phenomena can be truly simulated. So, the complexity of the problem itself demanded research on a large scale. The experimentation on large industrial furnaces is hampered by the fact that experiments can be done only with a loss of production and also the results are very much obscured by other disturbing factors, which have nothing to do with the problem itself. As an example may be quoted the ever-changing quality, rate and method of charging steel scrap, which make experimentation on open-hearth furnaces so troublesome.

Therefore, when the subject was being discussed between research workers from different countries, it was most useful that a large research furnace, which existed in the Royal Netherlands Steelworks, could be made available for this work; this would not only allow study of the problem apart from other disturbing factors, but also the joint efforts would make is possible to investigate the problem much more fundamentally and with many more variables than would have been possible for one of the participants only, also because the costs to run such a large research furnace are rather high. The subject now can be described generally as the study of combustion and heat transfer from luminous flames produced by the firing of gaseous, liquid and solid fuels.

In the participating countries, national committees have been formed, each sending representatives to a joint international committee under the chairmanship of Prof. Ribaud of Gaz de France. In charge of the studies in the research programme is Prof. Thring, formerly head of Physics Department of B.I.S.R.A., now Professor of Fuel Technology at the University of Sheffield.

From the outset, Great Britain, France, Sweden and Holland participated in the work and just recently also the U.S.A. and Belgium have formed national committees, while it is probable that one will be formed in Switzerland and eventually in Germany. The scope of interests can be estimated from the fact that the members of the national committees represent the ceramic, glass-making, fuel-oil, refractories, gas, cement and boiler-making industries.

Investigations are concentrated at IJmuiden, but parallel studies are carried out on much smaller models in laboratories in Paris, London, Sheffield, and Delft, with the purpose of concentrating on one particular aspect of the whole problem.

Trials Adopted

Early in the project the joint committee decided that the work on the large furnace should be split up into (1) performance trials, in which investigations should be concentrated on the overall effect of the variables in this particular trial, which could lead to immediate industrial application; (2) combustion mechanism trials, in which efforts should be concentrated on fundamental aspects of mixing, soot-formation, temperatures and emissivities of only one or two particular flames, in order to give the fullest information about all influencing factors.

The work of the Flame Radiation Research Joint Committee published up to now has been, so far as the work at IJmuiden is concerned, carried out on an industrial scale on an experimental furnace, now referred to as "the old furnace." As this furnace had, in course of time, become worn, and the joint committee had decided to build a new one, as well as a special furnace for pulverized fuel firing at IJmuiden, it was considered advisable and advantageous to construct a new experimental station for flame radiation research close to the laboratories of the Royal Netherlands Blast Furnaces and Steelworks. This combines under one roof the two

*From information supplied by Prof. G. M. Ribaud, director of research, Gaz de France, and president of the Flame Radiation Research Joint Council; Prof. O. A. Saunders, Imperial College, chairman of the British Committee; and Ir. G. W. van Stein Callenfels, research department, Royal Netherlands Blast Furnaces and Steelworks.

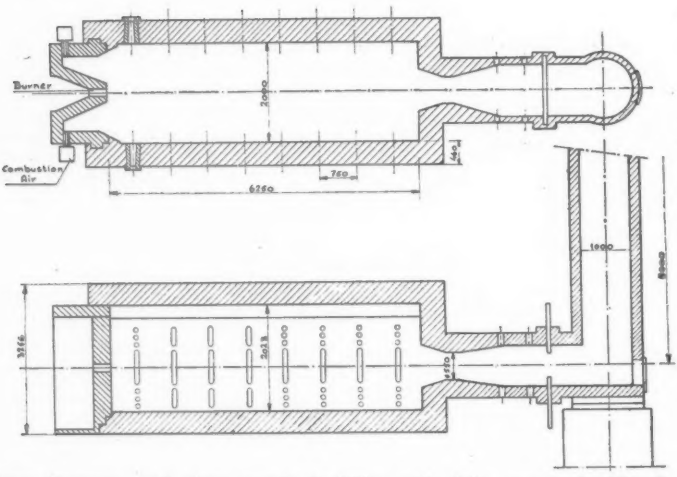


FIG. 1.—*Plan and elevation of the new furnace for flame radiation experiments (dimensions in mm.).*

new furnaces and gives ample facilities with full instrumentation for work of wide scope to be undertaken.

The new furnace was inaugurated on April 28 at IJmuiden, when representatives of many countries were shown the unit in operation. Included in the British contingent which numbered 35 were Prof. O. A. Saunders, chairman of the British committee for flame radiation research; Prof. M. W. Thring, University of Sheffield; Sir. H. Roxbee Cox, chief scientist, Ministry of Fuel and Power; Dr. D. T. A. Townend, director, B.C.U.R.A.; and Mr. N. van Marle, director, Gibbons Askam, Limited. Visitors were welcomed by Prof. G. M. Ribaud, president of the joint committee, and then a review of the aims and plans of the committee was given by Prof. Saunders. A description of the new furnace follows.

General Layout

The layout of the new station shows the two furnaces are placed side by side, with their burner ends towards the south. The southern part of the building is occupied by an instrument room which gives a central and open view of the two furnaces and by two auxiliary rooms for pumps, power distribution, stores, etc. On the north side, a specially equipped gas analysis room has been constructed in order to separate this specialized equipment from the rest. Outside the building on the southern side are the liquid fuel storage tanks, three in number, for different kinds of fuels. The combustion-air preheater and the coal-preparation plant for the pulverized fuel trials will be situated on the east side. The total cost of the completed installation and its services including all auxiliary equipment such as the preheater, the coal-preparation plant and the instrumentation will amount to approximately £60,000.

FURNACE No. 1 FOR OIL AND GAS FIRING

Combustion Chamber

The inner cross-section of this furnace is about 6 ft. square and its length 20 ft. (Fig. 1). It is thus of about the same dimensions as the old furnace. The construction of the side walls, through which the measurements must take place, had to be a compromise between what was required for thorough investigations (in effect, a wall consisting of holes and slits only), and what was considered to be necessary for a solid construction with adequate insulation. It had been found, in the old furnace, that vertical slots allowing for a continuous assessment, in height, of the flame characteristics, were very valuable. In view of the discontinuous operation of the furnace, and the frequent temperature-level changes, it was considered unwise to make slots over the whole height of the furnace.

Accordingly, the construction shown in Fig. 1 was finally adopted. With this design, the four slots in the later part of the flame have only a central slit while holes are provided for the rest. The width of the slots and of the holes is about 3 in., and in order to make the construction of the whole sidewall a stable one, specially-shaped bricks have been inserted.

Since the desired aim was to work at wall temperatures of 1,600 deg. C., it was necessary to use a high-quality brick which at the same time should show as little creep or growth as possible; for these reasons, sillimanite was chosen as the refractory material.

The complete wall is constructed of one brick (about 8½ in.) of sillimanite, a half-brick of porous sillimanite acting as a high-quality insulating brick, and a half-brick of ordinary insulating brick. The specially-shaped bricks are made of sillimanite.

Roof and bottom are of the same composite character as the walls. The whole furnace, except the roof, is within a light steel casing.

Whereas the old furnace was built on ground level, which meant that constant conditions could only be obtained at the expiration of a week, or longer, the new furnace is built clear of the ground, and rests on a set of beams. It may thus be possible to measure the heat losses through the floor. The burner end of the furnace is constructed as a loose panel, in order to give the possibility of rapid changes in design. To start with, the construction of the old furnace has been followed, the burner being in a receding entry, the air being delivered by means of wind boxes giving a fairly even distribution of the air in height.

The exit end of the furnace is constructed to provide a venturi-shaped waste-gas tunnel with the idea of improving the mixing before the waste gas samples are taken for temperature and gas com-

position measurements; in addition, this venturi may be used to measure the waste gas volume and provide a check on the waste gas analyses. A furnace pressure damper control is provided; this consists of two refractory plates sliding vertically in opposite directions; this arrangement was adopted to ensure that the flow through the venturi would not be affected by the use of an asymmetrical damper. The waste-gas tunnel gives access to a 25-ft. stack, specially designed to overcome friction losses in the venturi and waste-gas tunnel. The refractory material in the stack is high-quality fireclay brick backed by an ordinary quality insulating brick.

Design of Doors, etc.

Special consideration had to be given to the construction of the doors closing the openings in view of the large number of slots and holes in the walls. In this connection, it is important to state that work of a different character will be done through each of the side walls, the east wall being used for radiation measurements only, the west wall being designed for the insertion in fixed and known positions of all the various kinds of probe.

Because of the good results which had been obtained by the simultaneous displacement up and down of the radiation pyrometers, this system has been adopted on the new furnace. A horizontal beam was therefore designed on which all the pyrometers can be mounted with their supplies for water, clean air and wiring. This beam can be raised up and down by means of two long-screwed spindles mechanically coupled. The water-cooled doors have been made to slide along a pair of water-cooled tubes, one on each side of a slot. This sliding door, of about twice the furnace height in length, is counterbalanced, and thus easily moved up and down, by means of an interlocking pin on the horizontal beam.

In this way, the holes in the doors are always in line with the radiation pyrometers on the beam, and at the same time reasonable air tightness has been secured (see Fig. 2). On the west wall fixed doors have been provided to cover the slots; these doors have eight square holes with flaps, which can be used for introducing water-cooled probes.

On the outside of the furnace are a number of vertical pipes with sliding grips which can be used to fix in position probes or any other instruments. These arrangements enable a figure for inlet air ranging from 0 to 15 per cent. according to furnace pressure setting, the greater part of this inlet air coming through the openings in the sliding doors for the radiation pyrometers.

Supply and Control of Input Variables

In order to get the maximum results from the measurements taken on the flames, it is of vital importance that all input variables should be under complete control. The reason for the choice of automatic control is that full attention can then be devoted to the actual measurements.

Oil can be taken from three different tanks: it is then heated to a given temperature and pumped to the furnace. Two pumps are provided: one for quantities above 100 lb. per hour and an adjustable Diesel-engine fuel pump for the small quantities used for carburetting gas flames. The larger quantities are measured by means of an orifice specially designed for viscous liquids and working on a recording controller.

Steam (after being superheated in a small gas-fired unit), compressed air, coke-oven gas and oxygen, can be taken from the works mains, measured by orifices, and controlled to give a constant flow. Propane, if required, can be taken from a railway tank car, reduced in pressure, metered, and sent to the furnace.

The combustion air is delivered by fans. Once the air preheater has been installed, any air temperature up to 750° C. can be supplied. Furnace pressure, although not an input variable in the strict sense, is measured and controlled by an hydraulic controller, operating on the two dampers, which counterbalance each other.

Water both pure and from the mains is available for use with instruments, and also in ample quantity for cooling purposes. The measuring and controlling instruments for the input variables are mounted on one wall of the instrument cabin

The average load of the furnace will be roughly

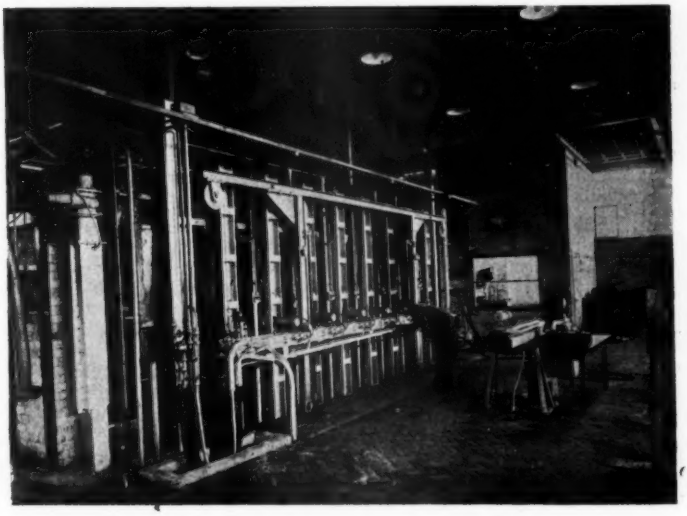


FIG. 2.—*Radiation pyrometers are fitted to traverse the slots vertically and so give readings at various heights.*

Flame-radiation Research

2.5×10^6 k/cal. per hour., *i.e.*, approximately 550 lb. of oil or 600 cub. m. coke-oven gas per hour.

No. 2 FURNACE FOR PULVERIZED-FUEL FIRING

Although no more than the foundations of this furnace are completed, a short description of the plan of construction may be useful to complete the picture of the new experimental station as a whole.

The furnace has been designed along the same lines as the oil and gas furnace, although it has a smaller cross-section (4½ ft. sq.) and is much longer (about 36 ft.), the ratio of length to cross section being about 7:1, as compared with 3.5:1 with furnace No. 1.

The furnace will be constructed with a wall thickness of 1½ bricks, as follows—one brick (8½ in.) of high quality insulation (hot-face) with a special coating against ash attack and backed by a half-brick of ordinary quality insulation brick. It will be equipped with the same arrangements of slots, doors, moving beams, etc.

The floor is to be inclined towards one side and small doors provided on this side in order to facilitate ash removal. As the quantity and location of the ash deposits in the furnace and stack is at present unknown and also the way in which the difficulties with loose or solidified ash will present themselves, the furnace design has been made so flexible as to be able to cope with such eventual problems. Some practical experience with the fuels to be used is necessary before a final design can be adopted.

The average load of the furnace will be of the order of 550 lb. coal per hour; by means of water-cooled pipes to be introduced through holes in the roof, the thermal load of the furnace can easily be varied between 20 and 70 per cent. It is also planned to equip this furnace with oil-burning facilities, in order to be able to compare the different types of fuel under exactly the same conditions.

The coal-preparation plant provides the furnace with dry pulverized fuel of widely different characteristics. It must therefore have maximum flexibility, and the separate operations of crushing, drying, milling and weighing are interconnected through storage hoppers. The capacity of the plant will be max. 10 cwt. coal per hour.

It is planned to burn coals ranging from anthracite to lignite or brown coal and from 8 to 30 per cent. ash content. It is hoped that this coal preparation plant will be ready for operation in December.

Air Preheater

While the availability of an air preheater was an essential requirement for work with pulverized fuel, it was nevertheless decided to provide an installation also able to supply preheated air to the oil- and gas-fired furnace and which will enable results to be compared with those obtained with cold air.

The use of the high-temperature waste-heat of the furnaces was considered for obtaining the preheat, but this idea was finally abandoned in view of the difficulties to be overcome, *e.g.*, in order to avoid having to instal two preheaters, it would have been necessary to use a common stack for two furnaces. Also, in view of the widely varying, and frequent changes in level of load of the furnaces during the trials, and of the wide range of preheat needed, a somewhat complicated system of control (including bypasses) would have been necessary. Further, the danger of upsetting the furnace pressure control, which is of such primary importance, would always have been present.

For these reasons, the joint committee decided to build a separately-fired preheater. It will be fired by blast-furnace gas (max. 1,600 cub. m. per hour), and will preheat the air to a maximum of 750 deg. C. The heater will be constructed of smooth alloy-steel tubes (Schack patent) which are suspended vertically.

The preheated air will pass through a refractory-lined tube to both furnaces. The instruments for measurement and control of this preheater will be mounted together with those for the input variables of the pulverized-fuel furnace on a separate instrument panel opposite the one for furnace No. 1. It is hoped that the preheater will be ready in July to enable trials with preheated air on the oil- and gas-fired furnace to start in August or September.

General Facilities for the Experiments

These facilities can be divided in different groups, each covering a certain class of work. The first group consists of six electronic recorders and one indicator, which are of a universal type, with interchangeable ranges and chart speeds. Some are line-recorders, others multipoint recorders. They record all the electrical outputs which are obtained with the furnaces, *i.e.*, radiation and suction pyrometers, thermocouples in walls and roof, heat flow meters, etc. All leads from both furnaces end in a panel from which any recorder can be connected, by means of flexible leads, with any measuring source.

The second group of facilities, those for gas analysis, are housed in a separate room near the furnace stacks; the equipment in this small laboratory is rather similar to that of a normal gas-analysis laboratory. In addition, are provided two gas-analysis recorders for CO_2, which allow rapid surveys of flow patterns in the furnace to be made, or can be used for recording the CO_2 content of the waste gases.

There is also a modified Bone & Wheeler gas-analysis apparatus for accurate determination of gas components; special provision is made for the sampling and analysis of carbon soot in the flame.

Both the instrument room and the gas-analysis room are kept under a slight air-pressure to minimize dust penetration.

The third group consists of instruments set up in a room in the central laboratories. These instruments comprise two black body radiation furnaces, with potentiometers for calibration of radiation pyrometers; thermocouples and heat-flow meters, and further equipment for analysis of gas and carbon soot samples (including an analytical balance). Finally, it should be mentioned that a small water-cooled furnace which has been in operation for several years in the research laboratories of the

Royal Dutch Shell Company at Delft, has been transferred recently to this new station. This furnace is a geometrically correct model of the oil- and gas-fired furnace, and has been, and will continue to be, used for testing scale effects on flame radiation under conditions which can be changed more widely and rapidly than is possible with the full-size furnace. This model furnace will be erected in a few weeks in the pump room, and will make use of all the facilities for control and experimenting which are already available.

Conclusion

It will be seen from the foregoing that the new station will provide every possible facility for doing a wide range of experiments on all kinds of flame. Oil, gas, propane, pitch, coal, etc., can be used as a fuel; combustion air with a pre-heat of max. 750 deg. C., and eventually enriched with oxygen, is available; steam, compressed air and oxygen can be used in any burner.

All the primary variables are controlled as to pressure, temperature, flow or other important properties; a range of universal recording instruments is available for measurements of temperature and radiation. A specially equipped gas-analysis room serves the need for both many and accurate analyses.

Two furnaces, well insulated and able to withstand temperatures of, respectively, 1,600 and 1,500 deg. C., have been specially constructed for the investigation of different kinds of flames. All this equipment is housed in a building which provides ample space for experiments, and where working conditions are the best that can be achieved.

Foundry Alloy, A—Z5G

Mr. L. Grand writing in *Revue de l'Aluminium* sets out the percentage composition of this alloy as follows:—zinc 4.5 to 5.5; magnesium 0.4 to 0.65; chromium 0.40 to 0.60, and titanium 0.15 to 2.5, the balance being aluminium. Permissible impurities are Fe 0.8; Si 0.30; Cu 0.30; Mk 0.4 per cent. as maxima. The alloy is susceptible to ageing, but is stable after three weeks to a month at room temperature or quicker (10 hrs.) at 180 deg. C. The stabilized alloy has the following mechanical properties:—Breaking strength 14.5 to 16.0 tons per sq. in.; elastic limit 10 to 11.5 tons per sq. in.; elongation 7 to 9 per cent. and Brinell hardness 60 to 75. A high casting temperature—between 710 and 720 deg. C. should be used. The alloy has a high shrinkage and suffers from cracking if the copper content exceeds that specified.

The alloy shows the following advantages. Its composition and structure is unaffected by repeated meltings. Thermal treatment is not necessary, as the alloy returns to its normal properties at ordinary temperature. The mechanical properties both static and dynamic are satisfactory, whilst resistance to shock is noteworthy. The mechanical properties of test-pieces taken from the castings were the same as the separately-cast test-pieces. The alloy readily machines and can be soldered or brazed. Finally it can be polished to give a brilliant or mottled surface, whilst its resistance to corrosion is satisfactory.

Britain's Relations with E.C.S.C.

The texts of the High Authority's letter of December 24, which contained its proposals and the Government's reply, and acceptance by the High Authority of the European Coal and Steel Community of the invitation to visit London were being laid before Parliament as a White Paper, it was said recently. The Government had not committed itself to anything at the present stage. M. Monnet obviously recognized that it would be impossible for the U.K. to enter into any form of association which would involve any surrender of sovereignty to a supra-national institution. In considering these matters the Government had taken full account of the views of other members of the Commonwealth and the views of both sides of the two industries as expressed through the National Coal Board and the Iron and Steel Board. They had also consulted the principal steel-consuming industries, through the Engineering Advisory Council. Consultations would continue during the proposed discussions.

In his correspondence, M. Monnet makes various proposals for strengthening the links between Britain and the Community. He suggests an association between markets involving the reduction and possible elimination of reciprocal protective measures, and the institution of rules which each party undertakes to keep. A procedure for common action, and the setting up of joint institutions to watch the operation of the system, to plan common action and to take decisions reached in common agreement, are also proposed.

M. Monnet thinks that the High Authority and the British Government should jointly examine the trend of the market and the living conditions of the labour force and should establish in common the long-term outlook for consumption and exports. Either party when contemplating important action should consult the other and offer the alternatives of common action for the whole of the two markets or allow the other party to proceed alone. In his view a "Council of Association" should be created consisting of three members of the High Authority and three representatives of the British Government. The council could meet periodically to discuss the application of the rules agreed for the trade between the markets, to plan common action, or to take decisions reached by common agreement.

In his reply, Sir Cecil Weir, the head of the U.K. delegation to the High Authority, said that a system of association, if it could be worked out, would be politically desirable and should enable economic advantages to be gained by both parties. The Government shared the view of the community that the association should lead to the development of international trade in the expanding world economy.

Changes in Transhipment Licensing Control

Consequent upon recent changes in export licensing control the Board of Trade are issuing a revised Transhipment Open General Licence which comes into force on May 11, 1954. The effect of this revised licence is to release certain goods, including natural rubber, from the requirement of individual transhipment licences. No additions are made to transhipment licensing control. The principal releases are certain mica sheets, certain metal working machine tools, mixtures containing carbon black, cobalt naphthenate, cobalt linoleate, steel-cored aluminium wire, aluminium multi-strand cable, certain ferro-alloys, platinum and platinum alloys and certain semi-manufactured goods of platinum. The revised open general licence is the Transhipment Open General Licence dated May 5, 1954. Copies are obtainable price 6d. (by post 7½d.) from H.M. Stationery Office.

New Equipment

Dynamic Coupling

The receipt in the editorial department of the JOURNAL of information from Heenan & Froude, Limited, Shrub Hill, Worcester, about the development and efficacy of their dynamatic couplings* led to the query regarding possible applications in the foundry industry. The outcome was a visit to West Yorkshire Foundries, Limited, Leeds, to see the use to which they are put there. What follows is an account of their use in connection with mould conveyors. It appears that the application of this unit to foundry drives, and particularly to heavy-duty conveyor drives, is quite new.

West Yorkshire Foundries, Limited, have a continuous, high-production casting line, comprising a pendulum conveyor with 89 palletts, each capable of carrying moulding boxes up to 20 in. cube. The approximate total weight of the loaded conveyor is 23½ tons. The length of track is 356 ft. It is T-shaped, transporting moulds from the machine line to pouring stations, and finally to the cooling area; the speed is infinitely adjustable from zero up to 20 ft. per min.

Owing to the weight of the conveyor and its route, two No. 3-size Heenan dynamatic couplings are used—each having the field circuit connected in series. In both cases, 7½-h.p., 960-r.p.m., squirrel-cage motors drive the input shafts of the dynamatic couplings by vee belts at approximately 720 r.p.m. Fixed reduction gears comprising directly coupled worm-drive boxes and final spur gears are identical—the two drives being mounted about 12 ft. above floor level.

In a control room is located one a.c./d.c. electronic rectifier fitted with multi-pin plugs and sockets and a spare rectifier similarly equipped. Also, the speed control-box for setting conveyor speed, and two ammeters in their respective motor circuits indicate accuracy of load-sharing between the two drives. In addition, two electronic overload protection units (one for each motor) are fitted, which will trip out both motor starters on the occurrence of an overload after a very short time interval. Formerly the only protection was mechanical by shear pins, and it was found the time taken to locate the pin and replace it was considerable and held up the complete production line while replacement and elimination of the defect was effected.

Now, if a stoppage occurs, the drives are tripped before failure of a shear pin and immediately the cause of the stoppage is rectified the drives are restarted. It will be appreciated that the starter "overloads" trip well after the time required to fracture a shear pin. The electronic overload unit has both motor and tripping-time adjustment, also an adjustable time delay which bypasses the trip unit during the two or three seconds required to overcome the inertia of the plant on starting, and under these conditions the motor current is about three times normal full load. The tripping current is set slightly in advance of normal full-load value.

The complete control of speed of the conveyor enables the optimum conveyor speed to be set for each grade and type of casting—taking account of variations in moulding machines, pouring, and cooling times. It is reported that, in the case of small castings, up to 20 per cent. increase in productivity has been achieved by installing the dynamatic couplers.

* Simply explained, a dynamatic coupling is a means of transfering a drive (usually an electric motor) to a mechanism to be driven, in such a way as to permit controlled slip and, hence, infinitely variable speed. No mechanical fastening exists between the two components, the drive being transmitted by eddy-current magnetic drag, excited by a variable d.c. circuit.

(*Continued at foot of col.* 2)

50 Years of Perfection

There can be few people who have not, in their more extravagant daydreams, wished to be the owner of a Rolls-Royce motor-car. To the enthusiast and layman alike the name has become a synonym for breeding, elegance, luxury, craftsmanship, and reliability: in short—perfection. Fifty years ago this month, the two partners in a famous enterprise met for the first time in Manchester. The aristocracy which is the hallmark of the breed is probably the direct contribution of the Hon. Charles Stewart Rolls, the third son of Lord Llangattock. In the mid 1890's he was a motoring pioneer, and in 1903 set up a world speed record with the prodigious speed of 93 m.p.h. He became a leading motor-car salesman in this country, but confined his activities to the best Continental cars, as he considered that there was no British car on the market good enough for him to handle—until he met Henry Royce.

Royce was an electrical engineer and a manufacturer of dynamos and electric cranes when, in 1903, he bought a second-hand French car. The noise and unreliability appalled him. With hand-picked mechanics and doing much of the precision work himself, he set about making three 10-h.p. two-cylinder cars. The first car was ready on April 1, 1904, and with the first pull of the handle it started—a rarity in those days which surely showed the pattern of things to come. When Rolls saw and drove the Royce car himself, he undertook to sell all the cars that Royce could make. The Edwardian aristocracy was changing to the horseless carriage and Rolls was aware of its demand for reliability, silence, and comfort, and many of his suggestions were incorporated. Rolls-Royce came into being at Christmas of that year.

In the Air

Rolls was not to live long to enjoy his success. The pioneer spirit was always with him; in 1910, he earned the unfortunate distinction of being the first Englishman to die in a flying accident. The air, however, presented more scope for Royce. In the same year he started to design the Eagle engine, which powered more than half the allied aircraft in the first world war. He died in 1933 a baronet and the designer of the engine which two years previously had won the Schneider Trophy outright for Britain.

To-day Rolls-Royce, Limited, joined by the Bentley group in 1931, is still in the forefront of car manufacture, and with its reputation enhanced by the Merlin aero engines of the last war, has moved into the jet age with engines—Avon and Nene and so on—for aircraft such as the Canberra, Valiant, Hunter, Swift.

THE Tyne tunnel is to be the next tunnel to be approved in the Government's road programme after the Dartford-Purfleet tunnel, said the Minister of Transport.

General-purpose Jack

A single-action, 10-tons capacity, general-purpose jack with automatic up-and-down action, to lift a full load on the head or the toe, is now being made by Richard C. Gibbins & Company, Limited, of Berkley Street, Birmingham. Solid fulcrums allow larger bearing surfaces and are integral with the socket. A ribbed and arched base is provided to give maximum gripping power. The jack has an overall height of 21 in., total weight of 59½ lb., and a maximum lift of both head and toe of 11 in. All components are interchangeable.

Association of Bronze and Brass Founders

Business and Social Meetings in London

General and annual meetings of the Association of Bronze and Brass Founders were held at the Connaught Rooms, London, W.C.2, on May 12. A very pleasing evening was spent on the previous day, when members and their ladies, after a cocktail party at Grosvenor House Hotel, visited Drury Lane theatre, returning to the hotel for supper and dancing. At the general meeting, a quantity of formal business was transacted and the following firms were admitted to membership:—W. J. Bloodworth & Son, Stroud; John Smith & Company (Derby), Limited, Derby; Meigh Castings, Limited, Cheltenham; J. H. Ritson & Son, Limited, Gateshead; and A. Kershaw & Sons, Leeds.

Presidential Report

This was followed by the president's report, in the course of which Mr. Marsland said:

Advisory Service

For the Association the past year had been one of great activity. First and foremost at present was the development of the Advisory Service. This service, which the Association had agreed with the Board of Trade to make available to the whole of the industry, represented a challenge to instil in this industry a sense of urgency and confidence to progress and to prosper. The Association had most of the progressive independent founders, together with many excellent "tied" foundries within its membership; it desired to spread this outlook to other foundries and so benefit not only the industry it served, but also the country.

In furtherance of these efforts to increase efficiency in the industry, meetings had been held in London, Wolverhampton, Glasgow, Leeds, Manchester and Newcastle-upon-Tyne. More of such meetings would be held in these centres and in others, too, if local firms so requested. The original sub-committee responsible for drafting the scheme consisted of Mr. Hobkirk, Mr. French and Mr. Lancaster, and he was grateful to them for their work and enthusiasm. He also paid tribute to the work of area chairmen and committees and gave especial thanks to Mr. Frank Hudson for his assistance with films and talks. He had noted with satisfaction the very good attendances at the "open" meetings and he hoped members would continue to extend the work by interesting their friends in these efforts.

Commercial Matters

Throughout the past year, the metal market had been not too clear, there had been little confidence throughout industry in the copper price and yet, despite the "bearish" outlook, it had remained firm and had even hardened; buyers had apparently worked on the smallest margins. These had not been easy conditions. Incidentally, London members interested in this subject would find it well worth their while to attend London-area meetings, where Mr. L. H. Tarring usually and very kindly gives a very well-informed talk on the state of the metal markets.

While talking of commercial matters, everybody was well aware of the return of the buyers' market. Buyers had been exerting pressure in many ways, but they should be mindful that a casting is usually a vital component of whatever it forms a part and quality should not be sacrificed to cheapness—for cheapness could be expensive.

Raw Materials

The Association also kept a watch on raw-material resources. Accordingly, it supported the appeal for the reservation of the sand deposits at Congleton, Cheshire, and he was glad to say there was now news that the Ministry of Town and Country Planning had allowed the appeal.

The Association was deeply concerned that working conditions in foundries should be healthy, safe and conducive to efficiency. It therefore gladly accepted an invitation from Her Majesty's Chief Inspector of Factories to be represented on a committee to advise him on such matters. The Association, together with representatives of the other branches of the non-ferrous foundry industry, would examine all proposals to ensure that they were reasonable, practical and leading to the ends in view.

Inspection Procedure

The Technical Committee of the Association had continued to do invaluable work. The conclusion of an agreement with the inspectorate of the Ministry of Supply on inspection procedure for copper-base alloy castings was a very great achievement and he expressed his admiration for the work done, especially by Mr. B. R. Higgins and Mr. R. Lancaster. He also placed on record the spirit of give-and-take and helpfulness of the inspectorate, under the chairmanship of Vice-Admiral Kelsey. The spirit in which they had responded to proposals augured well for the future.

Retirements

He recorded with great regret two retirements—that of Mr. G. A. Woodruff, who had retired from business life and who served the Association so well on the Council and as vice-president; his enthusiasm, realism and good humour had stood members in good stead. He regretted the loss of his services, but he was sure all would join in wishing Mr. Woodruff many happy years of retirement. Secondly, Mr. W. Smithson had given up the editorship of the *Bulletin*. The *Bulletin* was started only because he was willing to undertake the hard, uphill work of collecting and editing material for it, but it had come to be a much valued part of

the Association. He would like Mr. Smithson to know how much members appreciated all he had done, and was pleased that he was to remain on the Council.

Membership

The work of the Association was mainly of benefit to the whole bronze and brass foundry industry, but many of the firms in the industry had not yet joined. Why? Perhaps they could not see an immediate return for the money put into the Association; others, may be, just felt they had got along without the Association so far; but they forgot that they shared the benefits of the Association's work. He wondered how they would feel if no-one put forward the industry's case when matters vitally affecting it arose, as they did arise. No doubt they would say: "Someone should do something about it." He appealed, therefore, for other founders to give their support to the good work being done for the whole industry.

Finally, on retiring, he thought gratefully of all who had helped him during his two years of presidency—the Council who had constantly supported him, the Technical Committee, and others to whom he had so often turned for help and information. It had always been forthcoming and he thanked them all most heartily.

Technical Report

Following the valedictory address, the report of the Technical Committee was delivered by the chairman, Mr. R. Lancaster, as follows:—

After stating that a very useful and successful year's work had been done by the Technical Committee, Mr. Lancaster said that in last year's report he had referred to the first meetings with representatives of the Admiralty and the Ministry of Supply on proposals for a Code of Inspection Procedure for copper-base alloy castings. During the past year there had been three further meetings with representatives of the inspectorates of the Ministry of Supply, under the chairmanship of Vice-Admiral Kelsey, and complete agreement had been reached. As a result, copies of the Code would shortly be available to members and to other firms in the industry. The difficulty of reaching a comprehensive agreement on such a wide subject was obvious, and when discussions commenced there were many differences between the code proposed by the Association and the counter proposals of the inspectorates. That these differences had all been resolved amicably was due to the goodwill shown, the frank manner in which differences had been discussed and to the skilled chairmanship of Vice-Admiral Kelsey. He was pleased to state that throughout the negotiations the Association had received a great deal of encouragement and a fair hearing from the inspectorates which was greatly appreciated. Although the Code was not binding, the Association had satisfactory assurances that it would be observed. It was certain the industry would find it to be of very great assistance, and that if points of difference did arise, there existed a method of approach to inspection directorates which would enable them to be settled sensibly.

He had been present at all discussions on the Code but the member who had done most to ensure its success was Mr. B. R. Higgins, whose efforts he gladly acknowledged and to whom he extended thanks.

He regretted that there was no progress to report with the Admiralty in respect of the Code, as the matter was in abeyance as far as they were concerned; he was very hopeful that an opportunity might arise of discussing proposals with them in due course.

B.S. 1400 Revision

Another subject which was receiving a great deal of attention is the revision of B.S. 1400:1948. A working party on which the Association was represented by Mr. A. R. French—and Mr. H. T. Rutter for die-castings—was examining very closely the various proposals put forward which included, principally, a new layout for the specifications showing:—(1) Essential elements; (2) optional elements and important impurities; and (3) other impurities with a maximum for each which the supplier should undertake is not exceeded. Although the committee approved this layout in principle, the maxima to be inserted in section (3) were not easy to define, and the committee were examining the matter very carefully in order to make certain that the specification was tight enough to ensure good metal, without making it so tight as to increase the cost.

It was also proposed to increase the zinc limits in the ingot specifications for gunmetals, to allow for melting loss, and similarly to increase the phosphorus limits in the phosphor-bronze ingot specifications. The committee hoped that the new standard would be reasonably comprehensive, ensure satisfactory alloys for the foundryman, and be such that the Services would be able to adopt them.

Arising from the drafting of a new standard for valves, there had been some criticism of gunmetal specifications LG2 and LG3. Apparently, the mechanical properties called for in these standards were lower than the American, making the properties of British valves appear inferior. The A.B.B.F. members were reasonably certain that this was not the case, but a sub-committee had been set up to study the matter, and new specifications may be evolved for gunmetal valves. It was regrettable that there was at present insufficient information on the creep properties of these metals, and such information was fundamental to determine the point at issue. This could only be rectified by the provision of funds for the necessary research, but, as the matter was one of considerable importance to valve manufacturers, the provision of funds to enable the research to be carried out would seem to be amply justified. Whatever happened, the Committee was agreed that the two gunmetals 85/5/5/5 and 87/6/5/2 should be retained as they were such useful general-purpose alloys.

The Technical Committee had followed the con-

stitution of the Advisory Service for the industry with interest and would do whatever they could to ensure its usefulness and success. The Committee was frequently consulted by and had amicable relations with the Services. It also had close liaison with the British Non-Ferrous Metals Research Association and the Institute of British Foundrymen, which ensured co-ordination and economy of effort. The keenness shown by the members of the Committee and their ready help had been of the greatest assistance in contributing to the work achieved during the year and he thanked them for the support given.

Mr. Lancaster then reported with regret the resignation of Mr. F. Hudson and then closed the Report by thanking the secretaries—Heathcote & Coleman—for the great deal of assistance they had given the Committee during the year. During the later meetings with the Ministry of Supply on the Code of Procedure for Inspection of Copper-base castings, Mr. Rogers had acted as secretary to the joint committee.

Annual Meeting

Mr. W. R. Marsland presided at the eleventh annual meeting of the Association and, after dealing with a quantity of formal business, proposed from the chair the election of Mr. A. F. Raynor (Anti-Attrition Metal Company, Limited), as president of the Association for the ensuing year. This being accepted with acclamation, he invested the new president with the Association's badge of office. Immediately, on assuming office, he presented Mr. Marsland with a past-president's medal. Mr. W. T. Hobkirk (J. Hobkirk, Sons & Company, Limited) was then elected vice-president. This was an obviously popular choice and as such was heartily acclaimed. Mr. W. S. Lawson, Mr. Geo. T. Hyslop and the secretaries were reappointed as trustees. New or re-elected members of Council were:—Mr. W. R. Blakeborough (J. Blakeborough & Sons, Limited), Mr. A. R. French (J. Stone & Company (Charlton), Limited), Mr. G. T. Hyslop (the Phosphor Bronze Company, Limited), Mr. W. S. Lawson (Worthington-Simpson, Limited), and Mr. J. C. Sheckell (Billington & Newton, Limited). The members of the Technical Committee were all reappointed, but the Institute of British Foundrymen will be asked to nominate a person to replace Mr. F. Hudson, who has resigned his representation of that body.

The constitution of the publicity committee is made up of the president, vice-president and Mr. E. J. Brooke, Mr. R. Lancaster and Mr. A. P. Wright. The meeting finished with a vote of thanks, proposed by Mr. Marsland, to the Editors of the technical Press. Mr. V. C. Faulkner replied on behalf of Mr. Tarring, Mr. Beresford and himself.

After the meeting, the members lunched together in an adjoining room.

MISS PATRICIA HORNSBY-SMITH, M.P. (Parliamentary Secretary to the Ministry of Health) is to open the Pioneer Hostel for Rheumatic Sufferers at Bracken Hill House, Northwood, Middlesex, on May 25.

Personal

MR. W. CHAMBERS, managing director of Clayton-Chambers, Limited, steam-installation engineers, of Leeds, has been elected president of the Leeds Association of Engineers.

MR. RICHARD J. COLE, senior lecturer in Mechanical Engineering at the Rutherford College of Technology, Newcastle-upon-Tyne, is to retire. He joined the College staff in 1919.

DR. J. B. CONANT, United States High Commissioner for Germany and former president of Harvard University, is to open the new mechanical-engineering building at Birmingham University on July 2.

CMDR. L. J. F. HOWARD-MERCER has been appointed assistant to Mr. J. T. MacLeod, managing director of H. Widdop & Company, Limited, Diesel-engine manufacturers of Keighley (Yorks.).

MR. JOHN O. CRABTREE, vice-chairman of R. W. Crabtree & Sons, Limited, printing-machinery manufacturers, of Leeds, has been elected chairman of the Association of British Manufacturers of Printers' Machinery.

MR. BERNARD N. ZIMMER will retire as vice-president of the American Metal Company on June 30, having reached retirement age, but he will remain a member of the Board. He will have completed 40 years' service with the company.

MR. J. E. DUMBLETON was elected chairman of the Midlands Association of the Institution of Civil Engineers at the annual meeting in Birmingham on May 13. He succeeds Mr. T. H. P. Veal. Professor S. C. Redshaw, Professor of Civil Engineering at Birmingham University; Mr. R. H. Lee of Birmingham; and Mr. R. R. W. Grigson, county surveyor of Leicestershire were elected vice-chairmen.

MR. J. R. RIX, director in charge of research and development for the British Motor Corporation, Limited, is ceasing all business activities and is retiring to the South Coast on the advice of his doctors. Mr. Rix joined the Austin Motor Company, Limited, in 1917 and became technical manager and chief designer in 1947. In 1953 he was appointed a local director and became director in charge of research and development for the British Motor Corporation in January this year.

SIR JOHN RICHMOND is to retire from the deputy chairmanship and from the Board of G. & J. Weir, Limited, Glasgow. He is 85. In 1918 he received the honour of C.B.E., and became a K.B.E. in 1939. In his statement to the shareholders in the annual report of the company, Viscount Weir, chairman, says of Sir John: "He alone amongst us witnessed starting-up day at Cathcart, and from then onwards he has not only seen the company's development but has taken a leading part in directing its policy and progress."

THE MINISTER OF FUEL AND POWER has appointed SIR LAWRENCE BRAGG and PROFESSOR H. W. MELVILLE to be members of his Scientific Advisory Council from September 1. Sir Lawrence Bragg has been Fullerian Professor of Chemistry, Royal Institution since 1953 and resident professor and director of the laboratories of the Royal Institution since January. He was previously Cavendish Professor of experimental physics at Cambridge. Professor Melville has been Mason Professor of Chemistry, University of Birmingham, since 1948. He is a member of the research council of the British Electricity Authority of the Fuel Research Board and the Ministry of Supply Scientific Advisory Council.

News in Brief

THE MOTOR SHOW, this year, will be held at Olympia from October 25 to 30.

THE HEAD OFFICE of the Glenboig Union Fire Clay Company, Limited, formerly in Glasgow, is now at Glenboig, Lanarkshire (telephone: Glenboig 421).

SHEFFIELD UNIVERSITY has made the first award of the J. H. Andrew Research Fellowship, financed by Sheffield steel firms, to Mr. R. G. Ward, B.A., a Cambridge research student.

NU-SWIFT, LIMITED, Elland (Yorks), announces that the Royal Danish Navy has placed its first order for pressure-charge-operated Nu-Swift fire extinguishers. The Danish navy is the 15th navy to instal Nu-Swift apparatus.

DAVID BROWN TRACTORS (ENGINEERING), LIMITED, of Meltham, near Huddersfield, have received a contract worth £250,000 for industrial tractors and spares for the Royal Air Force, from the Ministry of Supply. Delivery is now being effected.

THE WEDNESBURY AND DARLASTON MANUFACTURERS' ASSOCIATION sent a party of 300 apprentices to the B.I.F., Castle Bromwich, last week. They were taken by special coach and after touring the Fair were entertained to tea by the Association.

A MEETING with the Chancellor of the Exchequer is being sought by the British Association of Machine Tool Merchants to discuss the "inequity and ambiguity" of the exclusion of second-hand machines from the new investment allowance proposed in the Finance Bill.

AN IMPROVED EMPLOYMENT POSITION and a high level of industrial activity in the area has been reported to the London and South Eastern Regional Board for Industry. At March 15, the total employed stood at 4,046,500, while the number unemployed, at 64,937, showed a decline of 12,841 on the previous month.

DESPITE strong overseas competition, the Newhouse (Lanarkshire) firm of Euclid (Great Britain), Limited, has secured an order worth more than £200,000 from the Swedish Government. The order is for 40 rear-dumper units. Delivery is due to start this week and the remainder will be shipped over the next few months.

MORE THAN 100 managing directors and general managers will attend, on May 21, at the Grand Hotel, Birmingham, the first Midland dinner of the Institute of General Managers, which was founded last November. Guests will include Sir Patrick Hannon, Sir Rupert de la Bere, Mr. W. R. Brown, M.P., and Mr. B. H. Leeson.

VILLIERS ENGINEERING COMPANY, LIMITED, Wolverhampton, have produced their 1,500,000th engine. The first Villiers engine, a 269-c.c. two-stroke motor-cycle unit, was built in 1913. Production is still substantially taken by the motor-cycle industry, over 75 per cent. of the lightweights built in this country being powered by Villiers, it is claimed.

COUNCILLOR G. P. WADDINGTON, a director of G. Waddington & Son, Limited, manufacturers of protective clothing, of Newland, Hull, has retained his seat on the Hull City Council, being returned as Municipal Association Group representative for University with a majority of 917.

THE SECOND ANNUAL MEETING of the Fry 25 Club was held at the Trocadero Restaurant, London, on April 30. Mr. John Fry, president of the club, was in the chair. Toasts were drunk to Mr. W. H. Lawrence, who retired on March 31, and Mr. V. C. Woodroffe, who retires at the end of May from the Eyre Smelting Company, Limited, and Fry's Metal Foundries, Limited.

A LARGE PARTY of professors, lecturers, and appointments officers last week completed a three-day tour of the principal factories of British Insulated Callender's Cables, Limited, at Leigh, Prescot, and Helsby, and the main works of Automatic Telephone & Electric Company, Limited, at Liverpool, to further the traditional close liaison between the companies and the universities and technical colleges.

THE HOUSE ORGAN of Newton, Chambers & Company, Limited, ironfounders and engineers, of Thorncliffe, Sheffield, contains an article dealing with the policy of retaining men at work beyond the normal retiring age. It says "We have nearly a hundred men working at 65 plus and are all the better for it. Indeed we have a score who are over 70 and not the least member of our community is 77."

CONSTRUCTION will begin this year of two large Klonne-type dry gasholders, with capacities of 5,000,000 and 3,000,000 cub. ft., at the Cleveland works of Dorman, Long & Company, Limited, which the company has ordered from Ashmore, Benson, Pease & Company, Limited, Stockton-on-Tees. Part of the large extensions in progress at the works, the holders will be used to store blast-furnace and coke-oven gas.

DURHAM COUNTY COUNCIL is to seek membership of the North East Industrial and Development Association to gain wider publicity for the county's suitability for industrial development, as part of its plan to prevent a threatened large-scale migration of labour. In the county's development plan it is estimated that about 43,000 men's jobs will be needed from new industrial projects if the existing population is to be maintained.

SPEAKING at the Industrial Gas Conference at Leamington on Monday, Mr. E. Julian Pode, managing director of the Steel Company of Wales, Limited, and a member of the National Industrial Fuel Efficiency Service, stressed the importance of closer co-operation between the gas and steel industries in improving fuel efficiency. In setting up new plants, he said, the coal, gas, and steel industries must co-ordinate their activities.

GARRINGTONS, LIMITED, have opened a £2,500,000 new high-speed plant at their Bromsgrove works to make blade forgings. The new plant is 87,000 sq. ft. in area. It will house 18 forging presses from 1,500 tons to 2,500 tons capacity, each served by automatic induction-heating equipment especially designed to deal with the irregularly shaped slugs. It delivers to the forging press 400 slugs an hour heated to 1,200 deg. C. with a tolerance of 10 deg.

WILLIAMS & WILLIAMS, LIMITED, manufacturers of metal window frames and doors, of Chester, who have just completed a £100,000 contract for a new casino at Ostend, have now secured orders worth £250,000 for frames for a new hospital at Lima in Peru. Delivery is to begin in August and be completed within a year. Mr. B. A. Williams, chairman and managing director of the company, has recently returned from a detailed personal survey of the Australian market.

A NEW LABORATORY BLOCK, which is being erected at a cost of £200,000 near the site of the Edinburgh

(*Continued on page 598*)

SUPINEX "R" IN USE—

Illustration of Binnacle casting in DTD 165 alloy by courtesy of Gascoignes Non-Ferrous Foundries Ltd., Slough.

SUPINEX "R"
CORE BINDER

AN ENTIRELY NEW TYPE OF BINDER, STARTLING IN ITS PERFORMANCE . . .

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News in Brief

(*Continued from page* 596)

works of Ferranti, Limited, is expected to be ready by October. Although it will enable the company to extend its research activities and free more space for production work, its main function will be to accommodate the group scheme fostered by the Scottish Council (Development and Industry) to further knowledge of techniques in electronics in Scottish industry.

" CRAFTSMEN IN THE MAKING " is the title of a "live" exhibition by apprentices arranged in Bonnybridge Public Hall for Tuesday and Wednesday, May 25 and 26, 1954, from 2.30 to 4.30 p.m. and 6.30 to 9.30 p.m. The exhibition, which has been organized by Smith & Wellstood, Limited, and Mitchell, Russell & Company, Limited, will be opened at 2.30 p.m., May 25 by Mr. R. L. Hunter, chairman of the Joint Apprenticeship Committee of the light castings industry, Falkirk district.

THE BRITISH ELECTRICITY AUTHORITY has placed contracts with A. Reyrolle & Company, Limited, Hebburn-on-Tyne, for switchgear for Goldington power station, Bedford, and Connah's Quay power station, near Flint, and equipment for the Hunshelf (Yorks) substation. C. A. Parsons & Company, Limited, Newcastle-upon-Tyne, have received contracts from the B.E.A. for high- and low-pressure pipework for Keadby power station, Scunthorpe, and Brunswick Wharf power station, Poplar, London.

THE COMMITTEE OF INQUIRY on the rehabilitation of disabled persons has fixed June 30, 1954, as the closing date for receiving written evidence. It is now requested that any persons or organizations wishing to give evidence and who have not already done so should submit their memoranda as soon as possible and, in any case, not later than June 30, 1954. Memoranda should be addressed to the Joint Secretaries, Committee of Inquiry on the Rehabilitation of Disabled Persons, Ministry of Labour and National Service, 32, St. James's Square, London, S.W.1.

LED by Mr. Clement Johnston, president of the United States Chamber of Commerce, 19 American delegates to the second International Conference of Manufacturers attended a reception and luncheon in Birmingham on May 18, given by the Engineering and Allied Employers' Association, Birmingham, Wolverhampton and Stafford District. Later in the day they visited the works of Joseph Lucas, Limited, and on the following day, the Austin works at Longbridge. The American party met representatives of the Federation of British Industries and the British Employers' Confederation in London on May 17.

REPRESENTATIVES of the Goscote works of Elkington & Company, Limited, who met a joint meeting of the public works, housing and health committee, of Walsall Town Council last week, revealed that £70,000 had been already spent in the control of smoke, fumes and noise. The meeting followed complaints by residents in the Goscote area culminating in a deputation to the Town Council. It was stated by a representative of the firm that the old foundry which had been a serious contributor to the nuisance has been closed, that a hand-fired boiler has been dismantled and that other steps are planned to rectify nuisances with regard to fumes.

AS A RESULT of a recent visit to the U.S.A., Mr. Clifford Shaw, a director of Shaw Processes, Limited, was able to open negotiations for 15 firms to take out Shaw-process licences, as well as arouse considerable interest in the products of Cliño Foundry Supplies, Limited, one of the associated companies. It appears that it is possible to land foundry equipment, for instance in North America, at a very competitive price indeed, and there seems to be every prospect of opening up a good market for such equipment, and particularly for the company's shell-moulding machine. Space was taken in the Cleveland foundry exhibition and Mr. Adam Dunlop, a director, was in attendance on behalf of both firms. Much interest was also shown in Canada, where Mr. Winnet Boyd (former chief designer of A. V. Roe (Canada), Limited) was formerly appointed to represent Shaw Processes, Limited, in the Dominion.

MR. F. LEONARD DAVIS, chairman and managing director of Smith & Davis, Limited, brassfounders, Wednesbury, and president of the National Hardware Alliance, complained that trade in consumer goods was hampered by Government trade agreements, when he spoke in Birmingham on May 5 at the annual " Contact Evening " of the Alliance. Such trade agreements " stopped short of consumer goods," he said. Mr. Davis also offered some criticism of facilities for B.I.F. visitors to Birmingham, and commended to the Fair management committee the idea of " making the stay of trade visitors more pleasant." He added that he appreciated the difficulties involved. " Far too many people shudder at having to stay in Birmingham longer than they have to —they want to get back to London or wherever they come from as quickly as possible," Mr. Davis said. He added that he had always deplored the lack of " get-together " facilities for visitors to the Castle Bromwich section.

Obituary

MR. GEORGE JONES, joint managing director of William Jones & Sons, Limited, ironfounders, has died at his Birmingham home. He represented the third generation in the firm which was founded by his grandfather, Mr. William Jones.

MR. ROBERT KENNEDY, a former director of Glenfield & Kennedy, Limited, Kilmarnock, has died at the age of 84. A great-nephew of Mr. Thomas Kennedy, founder of the firm in 1852, Mr. Kennedy took an active part in the management of the business. He served for a time as joint managing director and later as a director. He was particularly associated with the water-meter side of the business, a branch of the industry of which he had a highly specialized knowledge.

MR. DOUGLAS DIGBY HAWLEY, sales director of Hadfields, Limited, steel manufacturers and engineers, Tinsley, Sheffield, died on May 15 at the age of 59. He had been a member of the firm since 1919, and was appointed sales director last February. Some months ago he made a business tour of Europe. He served on the executive council of the British Steel Founders' Association, and represented Hadfields on a number of trade associations. He was also a director of Ernest Newell and Company, Limited.

THE DEATH took place recently of Mr. William Ewart Guy, at the age of 60. Mr. Guy was a director of Guy Motors, Limited, Wolverhampton, of which his elder brother, Mr. Sydney Guy is chairman and managing director. Until he retired from active work about three years ago because of ill-health. He was commercial director and of the Sunbeam Trolley Bus Company, and first joined Guy Motors in 1919. He was a member of the Institute of Mechanical Engineers and of the Institute of Transport.

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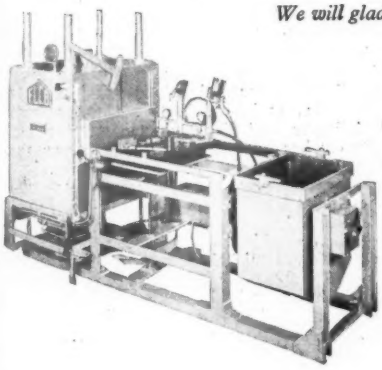

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236/39

Raw Material Markets

Iron and Steel

The whole of the output of the blast furnaces is passing promptly into consumption, and small tonnages of pig-iron are still being imported. The strength of the market lies in the continued demand for steelmaking iron. The transfer of blast furnaces formerly producing high-phosphorus iron to the manufacture of basic pig-iron has eliminated the discrepancy between supply and the requirements of the light-castings foundries, and all other grades of pig-iron are selling freely. This does not mean, however, that all is well in the foundry trade. Although the engineering and speciality foundries remain busy, other branches of the trade are seeking orders, and there is universal concern at the recent sharp increase in coke prices and the threat it carries of dearer pig-iron. The demands of the steelworks maintain overall needs, but there may well be a decline in foundry calls for iron supplies.

The lack of full employment for the re-rolling mills has had the effect of accelerating the shrinkage in the arrivals of steel semis of European manufacture. In any event, these must have declined as home steel-producing capacity increased, but this trend has been emphasized by the smaller requirements of the rollers of small bars and light sections. However, if trade in billets and blooms is quiet, steelmakers are handling a steady flow of orders for sheet bars and slabs which promises to continue throughout the summer months.

In the finished steel trade, the supply of steel plate no longer constitutes an industrial bottleneck. Sheetmakers still have big home and export sales. Bookings for rail deliveries or shipments before the end of June are no longer possible, but there is p'enty of business offering for Period III. Nor have the rollers of heavy joists and sections great reason to complain of the volume of specifications in hand. The general steel requirements of the engineering industry, the motor trade, power-plant producers, wagon builders, railways, and collieries are maintained at a high level and the outlook for the tube trade is brighter.

Non-ferrous Metals

Trading on the Metal Exchange last week was quieter, but there were some lively interludes, particularly in tin, where occasionally bidding was on a very brisk scale. On the whole, turnovers keep up well and it cannot be suggested that activity in Whittington Avenue is declining. Nothing very startling happened last week and prices did not show much change. Copper at one time stood at £245 for cash, but the close was no better than £243, which showed a loss of 15s. on the week; three months, on the other hand, finished 2s. 6d. better at £238 12s. 6d., so that the backwardation was reduced to £4 7s. 6d.—the lowest seen since the market opened. This closing-in of the gap between the cash and forward quotations is a noteworthy feature of the present situation and it is interesting to notice that even the forward price is now very close to 30 cents, which is the current level in New York.

Price changes in zinc followed the same course as copper, for May closed 10s. down at £79 10s., while August gained 2s. 6d. to £79 7s. 6d., with the backwardation only 2s. 6d. compared with 15s. a week earlier. Lead, however, closed 25s. up for May and £1 10s. better for August, the backwardation being £1 15s. Tin gained £11 in the cash position and £14 for three months to finish level, cash and forward, at £731.

Figures relating to March have been published by the British Bureau of Non-Ferrous Metal Statistics and these suggest that business is keeping up well. Stocks of virgin copper fell sharply to 47,258 tons from 60,084 a month earlier, while total consumption, virgin and scrap, was 48,607 tons, against 42,667 tons in February. For the first quarter of this year usage was 134,176 tons, fully 14,000 tons up on last year.

Consumption of all grades of zinc was 29,001 tons, compared with 25,286 tons in February, while at March 31 stocks of virgin zinc stood at 40,710 tons, some 3,000 tons up. Lead consumption also advanced, the comparison here being 29,442 tons in March, against 25,837 tons in February. Stocks of virgin lead at 28,312 tons showed a drop of 2,385 tons in comparison with February. Our consumption of tin was up by 314 tons to 1,987 tons, the best figure recorded since October, 1952. Total stocks, however, showed a reduction of 130 tons to 2,598 tons at March 31.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* May 13, £242 to £242 5s.; May 14, £242 to £242 10s.; May 17, £242 to £242 10s.; May 18, £241 to £242; May 19, £239 to £239 10s.

Three Months: May 13, £238 to £238 5s.; May 14, £238 5s. to £238 10s.; May 17, £238 10s. to £239; May 18, £237 15s. to £238 5s.; May 19, £236 to £236 10s.

TIN, Standard—*Cash:* May 13, £727 10s. to £728; May 14, £729 10s. to £730; May 17, £723 to £724; May 18, £721 to £722 10s.; May 19, £725 10s. to £726 10s.

Three Months: May 13, £727 to £727 10s.; May 14, £726 to £727 10s.; May 17, £720 to £722 10s.; May 18, £720 to £721; May 19, £726 to £726 10s.

ZINC—*May:* May 13, £79 10s. to £79 15s.; May 14, £79 5s. to £79 7s. 6d.; May 17, £79 5s. to £79 10s.; May 18, £79 2s. 6d. to £79 7s. 6d.; May 19, £79 5s. to £79 7s. 6d.

August: May 13, £79 to £79 5s.; May 14, £78 17s. 6d. to £79; May 17, £79 to £79 5s.; May 18, £78 15s. to £79; May 19, £79 2s. 6d. to £79 5s.

LEAD—*May:* May 13, £94 15s. to £95; May 14, £94 15s. to £95; May 17, £94 10s. to £94 15s.; May 18, £94 5s. to £94 10s.; May 19, £94 15s. to £95.

First half August: May 13, £92 15s. to £93 5s.; May 14, £92 15s. to £93 5s. *Second half August:* May 17, £92 15s. to £93; May 18, £92 15s. to £92 17s. 6d.; May 19, £93 5s. to £93 10s.

Another New Foundry Association

The formation is announced of the British S.G. Iron Producers' Association from amongst the licencees in Great Britain and Northern Ireland of the process under British Patent No. 630,070 and others for producing spheroidal-graphite iron castings. The Association has been brought into being to facilitate the exchange of information on the manufacture of this new material, and to encourage its use in the large diversity of applications for which it is suitable. Mr. P. A. Russell, B.Sc., and Mr. W. R. Cooper have been elected chairman and vice-chairman respectively, and Mr. C. Gresty has been appointed hon. treasurer. Over 80 per cent. of the active producers of s.-g. iron in this country are founder members of the Association. The secretariat and offices are at 94/98 Petty France, London, S.W.1.

The members are taking part in the exhibition organized by the Mond Nickel Company, Limited, to be held on May 25 to 27, at Park Lane House, London, W.1, which, it is hoped, will be attended by a large number of engineers and others who wish to obtain full information on the many uses of s.-g. iron.